CALIFORNIA WOOL PRODUCTION

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California wool

. . . is produced from many breeds of sheep, in all kinds of climates, and on widely varying soils. It cannot, therefore, be uniform in quality.

. . . as graded at the warehouse, is predominantly medium to fine, but it varies from fine Merino, free from defect, to poorly grown, short wools, with high dirt content.

This Circular

describes the California clip . . . what happens to it after it leaves the ranch . . . how it may be improved.

Here are some of the topics discussed:

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THE CALIFORNIA CLIP . . . it varies in grade, length, shrinkage, and freedom from defect

THE BUSINESS OF sheep and wool production is carried on in practically every section of California. This means that sheep are raised at elevations ranging from 10,000 feet to below sea level, in temperatures ranging from 125 degrees Fahrenheit to below zero. They are grown in some areas that are cool and humid, and in others that are hot and dry. They are pastured on thin infertile soils as well as on highly productive ones.

Breeds of sheep in California, therefore, are selected to fit particular climates. In sections of the state where fat lambs can be produced, up to 70 per cent of the grower's income may be from sales of meat; in the poorest, 60 per cent may come from wool.

With such wide differences in growing conditions, it is only natural that the clip should be greatly mixed in characteristics and require management practices somewhat different from those of other wool-producing states.

Despite the variety of grades that result, California wool is principally fine and half-blood wools of 12 months' growth, short in length. Only about 12 to 15 per cent of the two predominant grades can be called good combing or staple. Improvement in nutrition of the sheep and breeding for staple length may change this picture.

Because the different climates require different breeds, the percentage of shrinkage is more varied in the California clip. Soil conditions are also important.

Wools in some areas are heavily infested with burs and seeds; others are completely free of them.

Shearing goes on eight months of the year in various parts of the state

The fact that shearing is almost a full-year business in California is another factor that distinguishes wool production in this state. Spring shearing begins in the Imperial Valley in February, moving into the southern San Joaquin Valley in March. Late in March and throughout April and early May, the flocks of the Sacramento Valley are shorn. In May and June, shearers are busy in the mountainous areas, particularly in northwestern and northeastern California. Early July finds them on the north coast. Thousands of feeder lambs held over for fattening on clover pastures and ewe lambs kept for replacements are shorn in the two great valleys in June and July. Fall shearing of ewe bands is done in August and September.

In parts of California, sheep are sheared twice a year, whereas for most states this is an annual job. In sections where the climate is warm and dry in summer and "stickery" annual plants abound, sheep often become so infested with foxtail, broncograss, and filaree seeds that they lose weight because of irritation from the seed. The problem is most troublesome in the autumn when the animals have about 4 months' fleece. Since a ewe that is losing weight through irritation may not breed, many growers adopt the practice of shearing in August and September to free the ewes from "stickers." This is common practice in Solano and Yolo counties, where medium-wool sheep are popular.

Some growers shear twice a year regardless of need, believing that fall shearing increases the animal's thrift during the rainy season in winter and spring. Others follow the practice only when wool prices are high.

Whether or not shearing twice a year

Where the sheep business is carried on in California.

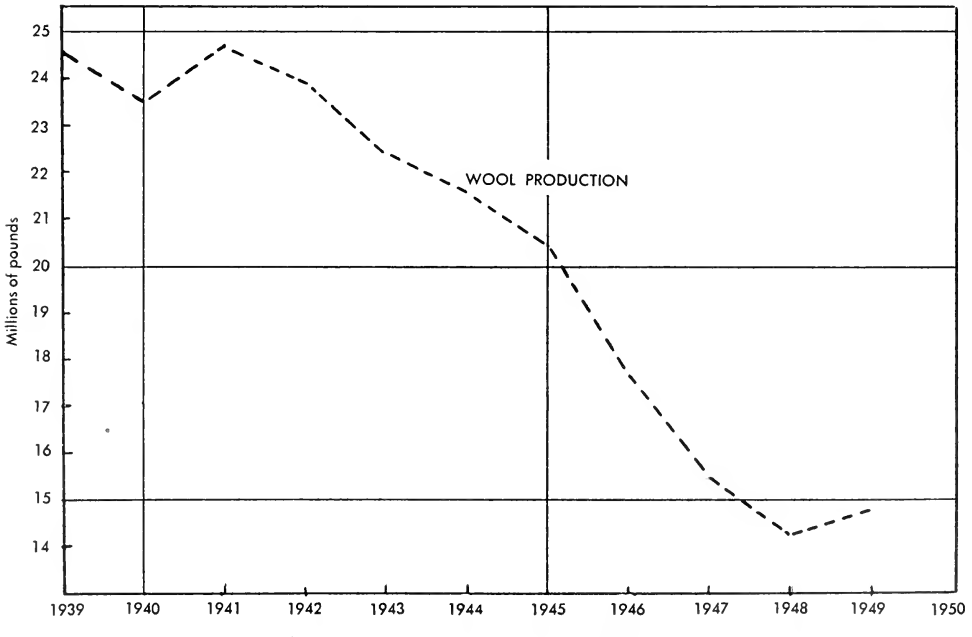
Each dot represents 10,000 sheep. Where less than 5,000 sheep are listed for any county, that county has been left blank. These data were obtained from California Crop and Livestock Reporting Service and give statistics for the year 1949.

in any one area is to be recommended depends partially on the kind of sheep raised. Rambouillets and Merinos have fleeces so dense that they are less affected by stickers than other breeds. On the other hand, medium-wool and coarsewool sheep may have fleeces so loose and open that certain kinds of seeds work their way through the wool, particularly on the belly. These seeds may even pierce the skin.

Nearly all shearing in California is done by machine. Shearing machines have been brought to a high state of perfection and reliability. Gasoline engines, driving dynamos, are mounted on small trailers that can be pulled by the shearer's automobile. A wire from the dynamo is run into the shed to provide current for several ⅓-H.P. repulsion-induction motors, which give each shearer his own individual power. Extremely light weight, portable, air-cooled gasoline engines are also available to run one- and two-man outfits for shearing small farm flocks. Machine shearing is faster than hand (blade) shearing. Neither method affects the rate of fiber growth.

Lamb's wool is produced in quantity in the state of California

Most California lambs are born during December, January, and February, when green feed is usually available. In April, May, and June, those that have attained satisfactory weight and finish are marketed with their wool on. However, in some years, limited spring rainfall causes seed to develop before the lambs are ready for market. In that case, they are often shorn to relieve them of stickers and to make them gain more rapidly in weight. Over most of the state, those not heavy enough or fat enough to go to market at weaning time are held for further feeding and marketed later in the season. These feeder lambs, and also the ewe



The downward trend of total wool production in California from 1939 to 1949.

lambs that are to be retained for replacement of breeding stock, are nearly always shorn.

The wool is largely of 3 to 7 months' growth and is short in staple. It has such a heavy bur and seed defect that practically all of it must be carbonized or be given a special treatment in carding.

Lamb's wool has a characteristic soft feeling, as compared with wool from older sheep, and is used for special textile purposes. It is always packed separately from the remainder of the clip and sold separately on the wool market.

Burs, stickers, and other vegetable matter are a problem in some sections

Burry wool is called "defective"; if not so infested, it is called "free." While the bulk of the clip produced in the northern coastal areas and in other mountainous regions is free, that grown in the Sacramento and San Joaquin valleys carries some defect. During World War II, when the Government purchased the nation's clip, California wool was penalized three cents a pound, clean basis, for defect.

If the defect in the wool consists of awns, foxtail, and broncograss seeds in moderate amounts, with an occasional cocklebur, the vegetable material can be removed mechanically (by carding) in the textile mill. If the infestation is heavy, and especially if either clover bur or awns or "beaks" from filaree predominate, the wool must be carbonized—an expensive process, the cost of which must ultimately be borne by the producer.

Carbonizing wool is really a misnomer. Actually it is not the wool that is carbonized but the vegetable matter.

Two different methods are currently used: the sulfuric acid and the aluminum chloride processes. They are equally effective, the choice usually depending on the type of dyes to be used later in the mill. The sulfuric acid process is the cheaper. Scoured, dry wool is immersed in sulfuric acid solution of 4 per cent to 6 per cent strength, at ordinary room temperature. It is allowed to soak for a variable length of time depending on the amount of burs present, but usually about 20 minutes. It is then passed through squeeze rolls, next going to a centrifugal extractor where the excess acid solution is recovered for further use. The wool moves on to a carbonizing dryer where heat evaporates the moisture, thus concentrating the acid which chars the vegetable matter into carbon. The dry, treated product is put through heavy iron rollers to reduce the carbonized burs to dust that can be shaken or blown out. The carbonized wool is then neutralized by soaking in a mild sal soda solution and is then dried again. Unless they are highly concentrated and left on the wool for

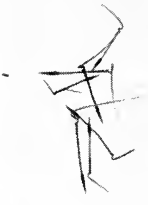
Lambs held over for replacement do better if shorn. These "shanks" were shorn in June, from a lamb in the Sacramento Valley.

Foxtail or barleygrass

Spring cocklebur

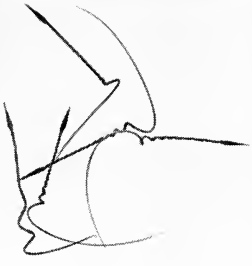
Star thistle

Clover bur or spiral bur in various opening stages



Red-stemmed filaree

Horehound



Broad-leaf filaree

Broncograss

Devil's claw

Common cocklebur

long periods, acids have little effect on the wool fiber itself.

Because of the recent installation of "Peralta rolls" on carding machines, carbonizing is now unnecessary in some plants. These rolls consist of heavy cylinders of solid steel. They are turned with utmost accuracy and squeeze the burs under tremendous pressure. The burs are pulverized and fall out as dust. The wool fiber is practically unaffected. At present large quantities of fall wool and lamb's wool that would be classed as carbonizing lots receive only this treatment.

Here is how California is divided according to the types of wool grown.

The numbers on the map correspond to the numbers in the left-hand column of the table.

Producing area
California
1. North coast
2. Coast Mendocino
3. Regular Mendocino
4. Territory or Border Nevada
5. North Central
6. Sonoma and Solano
7. Middle counties
8. San Joaquin
9. Southern Coast Counties
10. Southern Counties

TABLE 1. The California Wool Clip

Counties and parts of counties included	Predominant grades produced	Classification (per cent)	Comment	Average shrinkage (per cent)
Entire state	58's to 70's	12–15 good combing 75 French 10 Clothing	0 to 2 per cent vegetable defect; lacking in staple length; uneven in grade, shrinkage and character; poorly prepared; used primarily by top makers	56 to 58
Del Norte and most of Humboldt	36's to 56's	Combing and preparing	Only area in California producing low wools. Lincolns, Romneys, Cotswolds, some Corriedales	35 to 40
Coast of Mendocino and Sonoma; all of Marin. (Land near sea)	50's to 64's	20 combing 75 good French 5 avg. French and clothing	Whiteface crossbred types preferred by most growers	43 to 48
Most of Mendocino, part of northern Sonoma, small part of Humboldt. (Inland mountainous area)	64's to 80's	10 combing 20 good French 55 avg. French 15 clothing	Most attractive fine wools produced in California. Nearly all Merinos	52 to 56
Siskiyou, Modoc, Shasta, Lassen, Plumas, Alpine, Mono, Inyo, east. Sierra, Placer, Nevada, El Dorado, Amador	60's to 64's	15 combing 40 good French 35 avg. French 10 clothing	These wools have all the characteristics of Territory clips and are often sold as Nevadas	61 to 64
Trinity, Tehama, Glenn, Butte, Lake, Colusa, Sutter	58's to 70's	15 combing 60 good French 15 avg. French 10 clothing	Fairly well grown. Rambouillets and crossbreds—Rambouillets preferred	55 to 60
Southeastern Sonoma, Napa, Solano, Yolo	56's to 60's	Spring clip: (7–8 months) 15–25 short Fr. 75–85 clothing Fall clip (4–5 months) 100 clothing	Twice a year shearing. Well grown but short. This area has many stud flocks and is the center of ram production in the state	Spring 45 to 50 Fall 55 to 60 Lambs 40 to 45
Yuba, Sacramento, San Joaquin, Contra Costa, Santa Clara, Stanislaus, Mariposa, Tuolumne, Calaveras, west. Sierra, Nevada, Placer, El Dorado, Amador	58's to 70's	10 combing 20 good French 60 avg. French 10 clothing	Mostly fine. Variable in character	52 to 58
Merced, Madera, Fresno, Kings, Tulare, Kern	60's to 70's	15 combing 80 French 5 clothing	Best spinning wools in California. High shrinkage but well grown. Free or nearly free of defect	60 to 64
San Mateo, Santa Cruz, San Benito, Monterey, San Luis Obispo, Santa Barbara, Ventura	48's to 56's	5 combing 90 avg. French 5 clothing	Poorly grown, taggy and unattractive	54 to 58
Los Angeles, Orange, San Bernardino, Riverside, San Diego, Imperial	60's to 70's	10 combing 40 good French 30 avg. French 10 clothing	High dirt content, poorly grown	Spring 64 to 66 Fine fall 66 to 68 Lambs 45 to 55

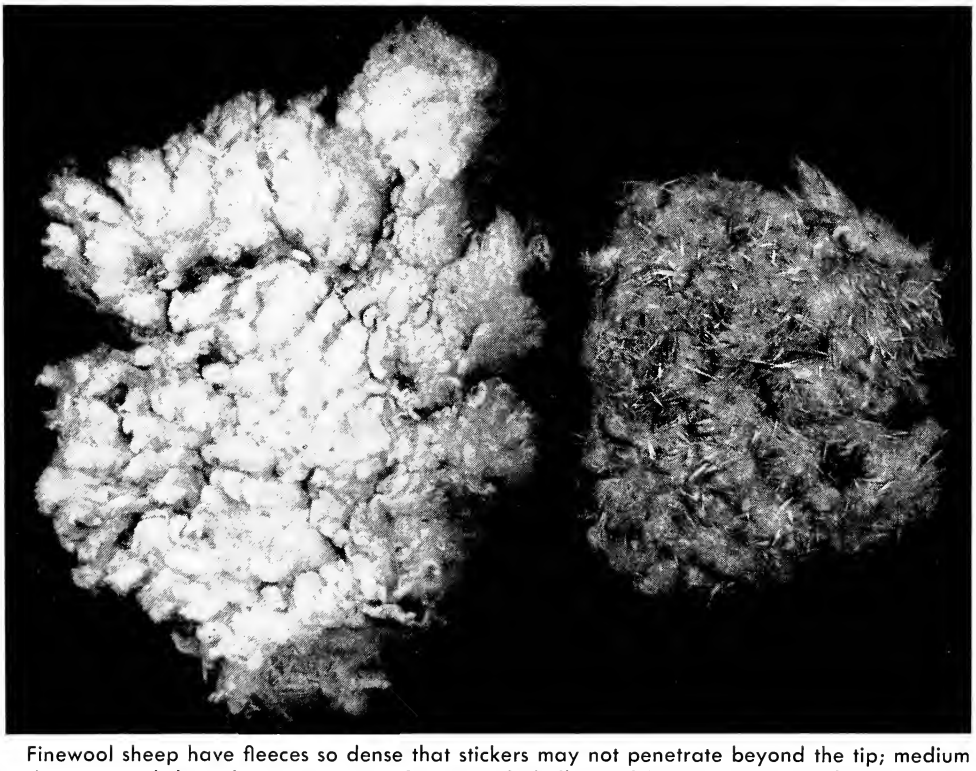
WOOL GRADING . . . how and why this process is accomplished in the United States

Why grading is necessary. Because products made from wool vary so greatly, each requiring a particular grade, the raw wool *must* be graded before it is used by a textile mill. Each kind of wool textile, whether knitted material, woven goods, or felt, is made of certain grades only. Moreover, each mill is interested only in wool suited for the particular specialties it manufactures.

For example, fine wool from Merino sheep cannot be successfully used to make carpets. The nap or pile would be so soft and fine that imprints from shoes would make such a rug unsightly. The manufacturer of floor coverings must have a type of wool containing a large proportion of relatively stiff, unyielding fibers that will spring back to their original condition after being bent or distorted by human feet. He chooses, therefore, very coarse wools from Lincoln or Cotswold sheep, or carpet wools from Asiatic countries. On the other hand, a manufacturer of worsted goods for men's suits cannot use a single fleece of the type used for carpets. Cloth from such wool would be heavy, harsh feeling, and stiff. Worsted "dress goods" require only the finer grades of combing length that will spin into fine, soft yarn. All manufacturers, therefore, buy only graded wools or *original bag* clips.

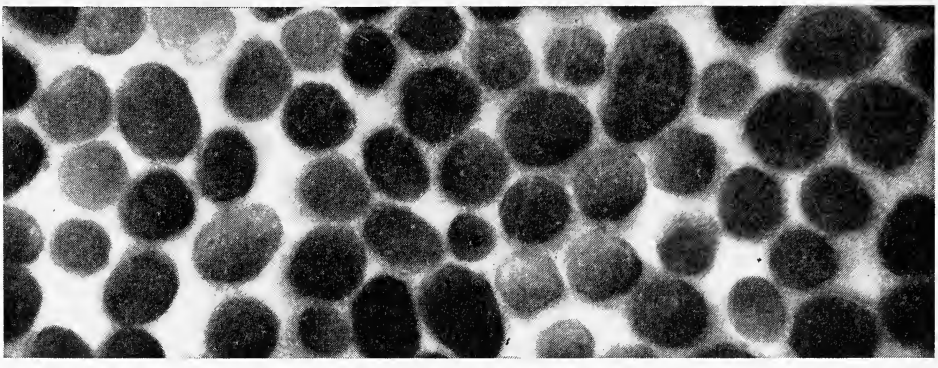
A glossary of wool terms, commonly used in the trade, will be found starting on page 50.

The basis for grading wool. The diameter of the fiber—in other words, its degree of fineness—is the basis on which

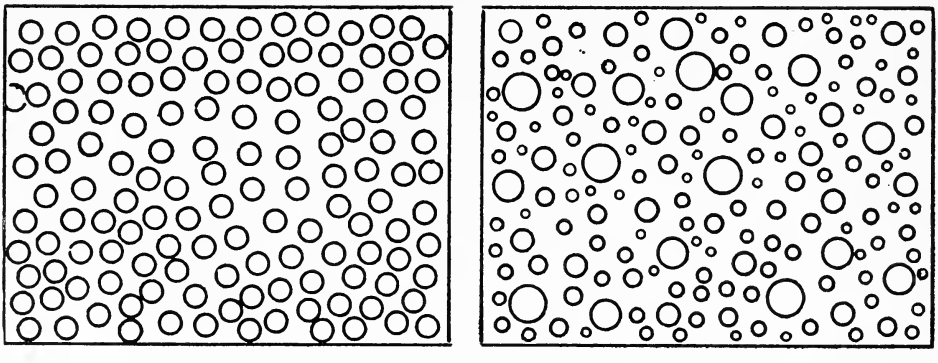


Finewool sheep have fleeces so dense that stickers may not penetrate beyond the tip; medium and coarsewool sheep have more open fleeces. Left: belly wool from a Merino. Right: belly wool shorn in the fall from a Romney grown at Davis, California.

WHY WOOL MUST BE GRADED BY EYE



Greatly enlarged photo of a bundle of wool fibers, sliced at right angles with a razor. This sample is fairly even in diameter, but it will be noted that some of the fibers are much larger than others.



Why wool is graded by eye. Drawings represent cross sections of staples of wool. If sample were like that on left, one fiber would give the average; if like that on right, many fibers would have to be measured to arrive at a true average. Wool is more nearly like drawing on right.

wool is graded. The actual measurements required to establish the grade in which any sample of wool belongs have been set by the U. S. Department of Agriculture. These measurements may be very valuable when disputes arise over contracts, but they are not otherwise used in commercial grading. The reason is a practical one. Each sample of wool from any fleece of any breed contains some fibers much coarser than others. To establish the average diameter of the sample, hundreds of individual fibers must be carefully measured if the average is to be accurate enough for use.

To illustrate, suppose that "A" has $700 and "B" has $300; their total combined wealth is $1,000. Since there are two men, their average wealth is $1,000 ÷ 2, or $500 each. This average is of little value because it does not give a clear idea of how much either man has. But if "A" has $501 and "B" has $499, their combined wealth is $1,000 and their average wealth, $500. This is a very valuable average, because it expresses almost

exactly how much each has. Similarly, if we wish to determine the average diameter of a piece of carefully drawn copper wire, it may be necessary to take only one or two measurements to get a good average. On the other hand, to get the average diameter of a hundred short lengths of wire, each of a different diameter, we might have to mix them thoroughly and measure half of them before we could place much confidence in the results. In the same way, the relatively large variation in the diameters of wool fibers in any sample would necessitate so many measurements and involve so much time and expense that it would be quite impractical for most market uses. For this reason, wool is graded by eye. The men who do it have learned from experience to judge the average fineness of the fibers by looking at the sample.

What the grade names mean. The American wool market has two different systems of naming the grades of wool. Both are based on the fiber diameter.

The spinning-count system is of British origin and is used throughout the principal wool-growing countries of the British Commonwealth. The numbers, such as 80's, 56's, indicate the number of hanks of yarn, each 560 yards long, that can be spun from a pound of scoured and combed wool of that particular fineness. The finer the fiber, the finer (or smaller diameter) the yarn that can be spun from it. Thus, each pound of graded 80's, after being combed, can be spun into 80 hanks of yarn, and since a hank is 560 yards, the total length of yarn from the pound would be 80×560, or 44,800 yards. This is a little over 25 miles. On the other hand, a pound of 36's will spin only $36 \times 560 = 20{,}160$ yards, or about 11.5 miles.

In actual mill practice, wool is very seldom made into yarn as fine as the spinning count indicates, even though it is mechanically possible to spin it to a count higher than that estimated by the grader. For most of the soft dress goods, an 80's wool is not usually spun above 60's, and a coarse wool, such as 36's, is normally spun to about half the indicated spinning count. To spin these wools to the count estimated by the grader requires infinite care in every step of textile manufacture, and for most textiles the cost would be greatly increased. It is obvious that at present the "Bradford" or spinning-count system so widely employed in the world's

TABLE 2. United States Grades of Wool

Spinning-count system	Corresponding older American system	Spinning-count system	Corresponding older American system
80's, 70's, 64's	Fine	46's	Low ¼-blood
62's*, 60's, 58's	½-blood	44's	Common
56's	⅜-blood	40's, 36's	Braid
50's, 48's	¼-blood		

* A grade widely used in trade, but not yet recognized officially.

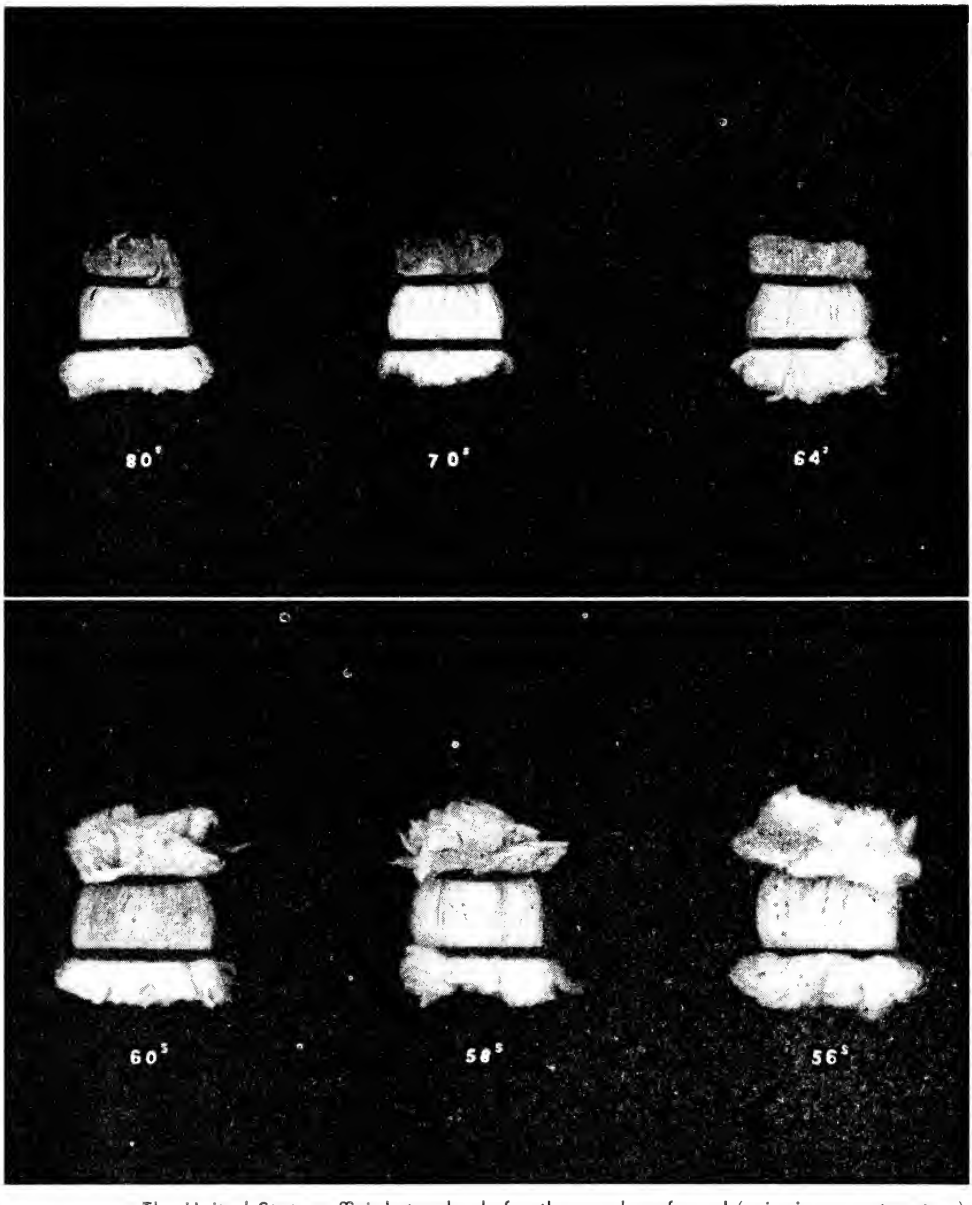
wool markets is just a series of arbitrary figures describing the fineness of a fleece, a staple or lock within the fleece, or a fiber within the lock. The grader who grades a fleece as 56's may be accurate in his estimate, but the manufacturer who buys it may make a 32's yarn from it if he wishes.

The "American" system makes use of different terms. "Half-blood," "quarter-blood," etc., came into use about the time Merino sheep became popular in the United States. This was about 1810. Before then, the country's flocks were rough, coarse animals. Fine wool from Merinos came into great demand and breeders began crossing Merino rams on the common sheep to get a finer wool. At one time, a half-blood wool was presumed to have come from a sheep that was of one-half Merino blood and one-half common sheep; a quarter-blood was presumed to have been grown on an animal that was one-fourth Merino blood and three-fourths something else. But like the grade names under the spinning-count system, these American grade names no longer have any reference to the breeding of the sheep that grew the fleece. A registered Southdown usually produces a fleece that grades half-blood. It has no Merino blood in its ancestry. Conversely, a Corriedale sheep is half Merino, but the standard wool grade for the breed is a three-eighths blood. The American system of grade names, while still used, is being gradually displaced by the spinning-count system, which has 13 grades instead of 7, is less confusing in terminology, and fits the needs of modern manufacture better. The United States and Canada are the only countries in the world that employ the American system of naming grades. For the industry, it would be better to discard this terminology altogether.

Standards for the grades. After conferences with several foreign countries, the U. S. Department of Agriculture, established, in 1926, standards for the various grades, employing both English and American systems. Small locks or samples are examined in the Wool

TABLE 3. Grades of Wool to Be Expected on Purebred Sheep of Various Breeds in California

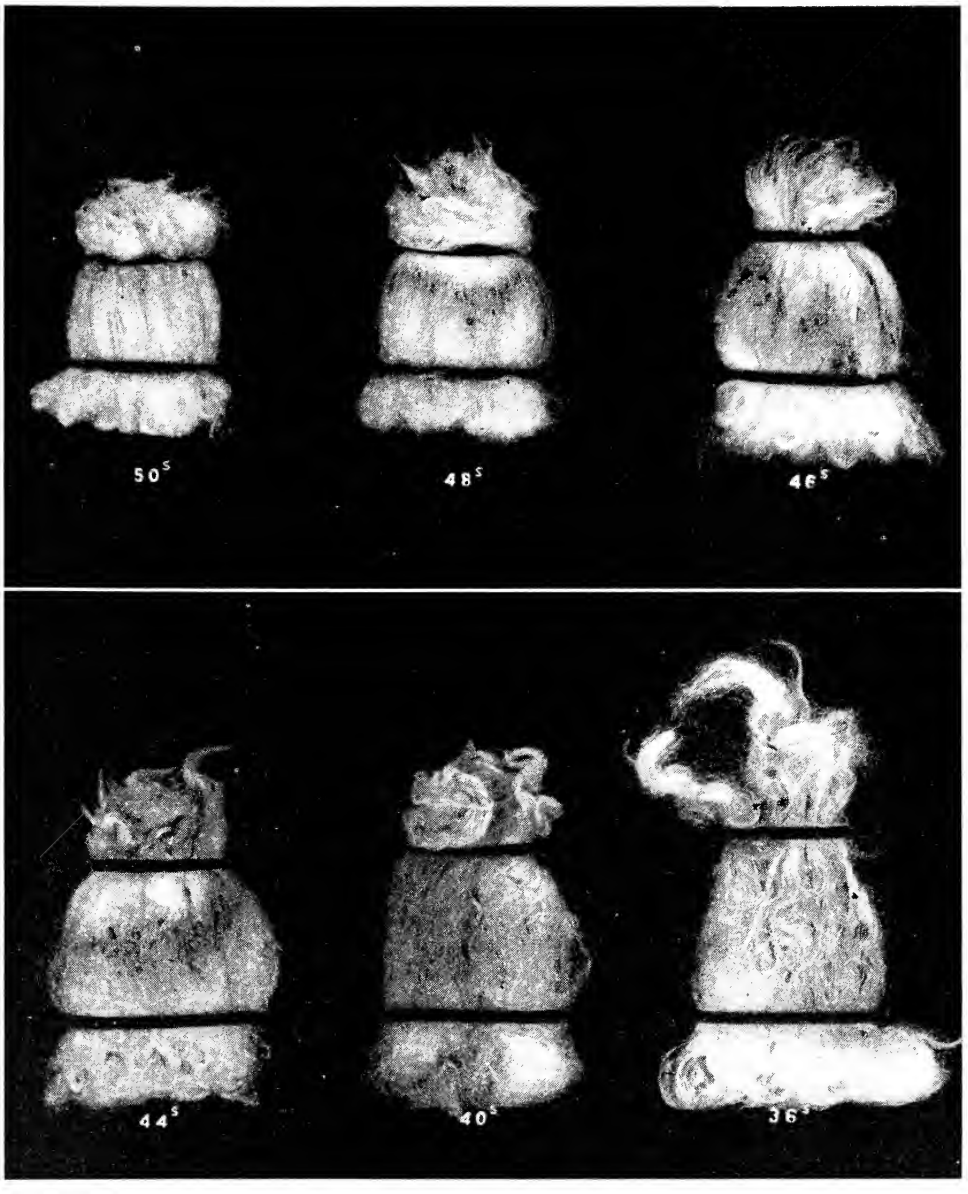
Classification	Breed		Grades of wool expected*
Finewool breeds	Blacktop Merino		64's*, 70's, 80's
	Delaine Merino		64's, 70's*, 80's
	New Zealand Merino		58's, 60's, 62's*, 64's
	Rambouillet		64's, 70's*, 80's
Medium-wool breeds	Blackface or Down breeds	Suffolk	50's, 56's*, 58's
		Hampshire	50's, 56's*, 58's
		Southdown	56's, 58's*, 60's
		Shropshire	50's, 56's*
	Whiteface breeds	Corriedale	48's, 50's, 56's*, 58's, 60's
		Romeldale	58's, 60's, 62's*, 64's
		Columbia	48's, 50's, 56's*, 58's, 60's
		Dorset	48's, 50's*, 56's
Longwool breeds	Romney		44's, 46's*, 48's
	Lincoln		36's*, 40's
	Cotswold		36's, 40's



The United States official standards for the grades of wool (spinning-count system),

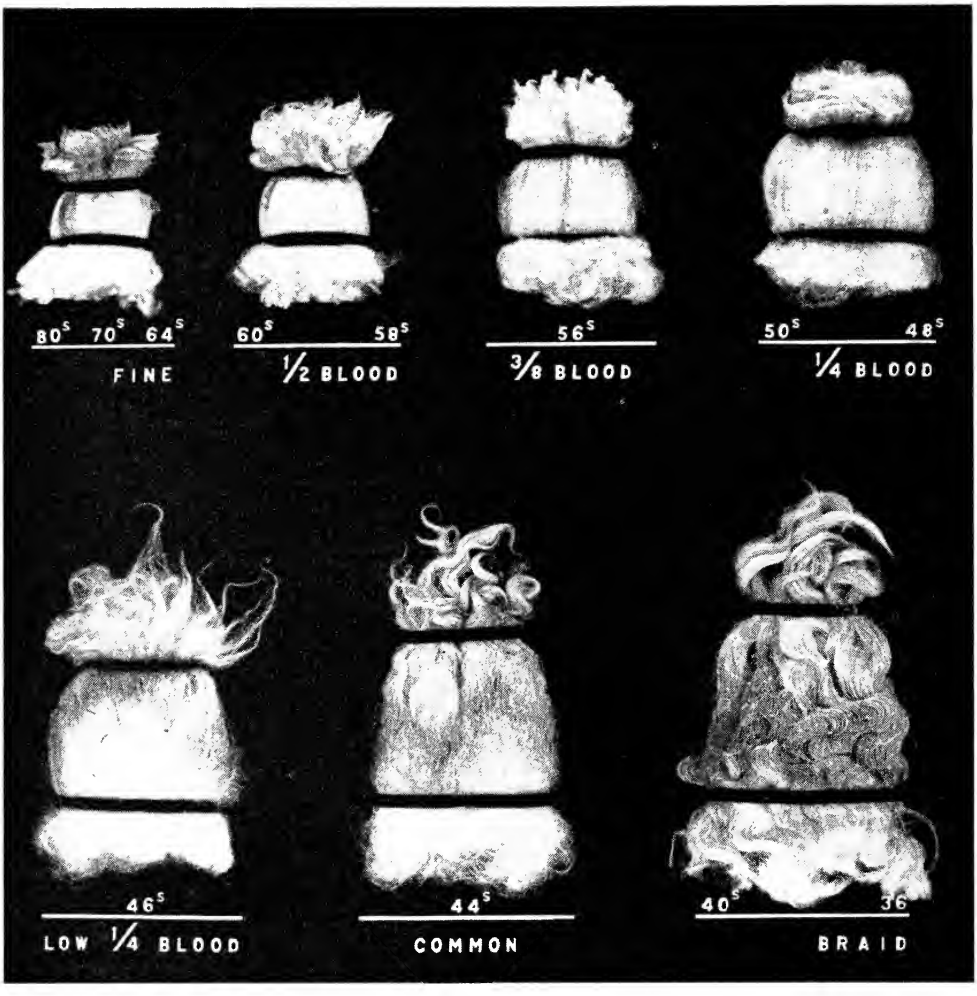
Standards' Laboratory in Washington, D.C., and those that meet requirements are mounted and made into sets to be used by the wool trade. The use of these standards by handlers and mills is voluntary, but wherever wool is graded in warehouses licensed by the federal government, graders are presumably required to use them as guides. This requirement enables a grower whose clip has been graded to borrow money on his warehouse receipt.

Quality. The term "quality" in the wool market applies to the fineness of fiber. It has no reference to the goodness or the desirability of wool. If a wool grader were asked the question, "What do you think of the quality of this fleece?" his answer might be, "This is a 60's," or "This is a 48's."



from 80's to 56's . . . and the official spinning-count system standards from 50's to 36's.

Grading procedure. Wool received at a warehouse is brought to the grader on a hand truck, and the bag is opened down its long seam by unravelling the lock stitch. The fleeces are placed on the grader's table. The source of light is very important. Wool cannot be successfully graded in direct sunlight or in artificial light. A north exposure is preferred. The grader removes a small lock or "staple" from the fleece, preferably grasping it by the tip or weather end, and examines it for fineness. He usually holds the staple firmly at both ends and snaps it with his middle finger to test its strength. If any doubt exists, he may test two or three such staples before turning the fleece over and repeating the operation from the other side. While determining the grade and testing the strength, he notes whether



The United States standards for the grades of wool, under the old system of Half-blood, etc.

the fleece is uniform in average diameter of fiber and observes the length to decide whether the wool can be combed. The entire operation requires but a few seconds if the grader is experienced.

Fleeces that "run out" on the britch (that is, fleeces much coarser on the thigh than on the shoulder and neck), are often "thrown down" a grade. This means that a fleece which might grade 60's if it were uniform, is put into 56's. Some fleeces may be thrown out of the grading line altogether, if they are off color, stained, or cotted, or if they do not match the others for any reason. Such fleeces are called "offs." At times, a clip of the finer grades may warrant making up more than one line of the same grade, the difference between them being based on shrinkage. (See page 19.)

Line fleeces. In grading any lot of wool, the grader often comes upon fleeces midway between two grades. These are line fleeces. His final decision for placing them will be based on the market demands at the time.

Grades of wool to be expected on purebred sheep of the breeds commonly used in various sections of California are shown in table 3.

Classification of wool for length. While determining the grade of the fleece, the grader classifies it for length. Length of staple is of primary importance among

the finer grades (56's and finer) because, generally speaking, the finer the fiber, the shorter the staple. A large proportion of the American clip is too short to be combed and made into the more expensive types of goods. Wools long enough to comb are more valuable than those too short for the combing process; in consequence, the two categories are separated.

The finer grades of wool are combed on one of two types of machines: (1) the Noble or English comb, (2) the Heilman or French comb. The French comb has a much less productive capacity than the Noble but will handle shorter stapled wools. Wools too short to be combed economically on either system are called clothing wools. The term clothing wool does not mean wool suitable for making clothing but simply refers to the length.

There are no official standards for length but, by common acceptance in the trade, 64's and finer must meet the following minimum lengths:

Combing, 2½ inches
French combing, 1½ to 2½ inches
Clothing, under 1½ inches

For each grade below fine, the minimum lengths increase by ¼ inch. For example, a 56's is two full grades below fine, and the minimum requirements become:

Combing, 3 inches
French combing, 2 to 3 inches
Clothing, under 2 inches

Strictly combing wools are often referred to as *staple* wools. Coarse wools are not usually classified for length, since practically none of them is too short if of 12 months' growth. French combing wools approaching strictly combing length are often called "big French," and clothing wools are sometimes called "stubby" in the trade.

Which grade of wool is the best? Sheepmen often ask this question. There is no correct answer. Each grade and length has its own role to fulfill, and its desirability depends entirely on what it is to be used for. The grower should select the breed of sheep best adapted to the region in which they are to be kept. If that breed happens to be the Corriedale, the best grade of wool for him to produce will probably be a 56's, and he should strive to produce as uniformly excellent 56's as possible.

From these explanations, it will be seen that both grades and lengths are necessary. To say "this fleece is a 70's quality" describes its fineness, but gives no indication as to whether it belongs in the most or least valuable classification for that grade. But if the fleece is described as a 70's strictly combing or a 70's staple, the buyer is assured that the fleece can be combed on a Noble comb and made into worsted goods.

It is impossible for any wool grower to produce a clip all of one grade, no matter how much care he takes in breeding and culling his sheep or how well they are cared for. Sickness, lambing troubles, storms, age, and accidents in the flock may all be reflected in the grade and length of the fleece at shearing time.

Some growers in the western states pay much attention to the uniformity of their sheep. As a result, the clip may have such a high proportion of one grade that the cost of grading by a dealer would not be justified. Such wool may be sold by the handler direct to the mill. A clip meeting this description is called an original bag clip. Market reports often quote sales "original bag." These clips are usually graded at the mill buying them.

Why wool is not graded on the ranch. Very few clips in the United States are graded at the point of production. This is in contrast to those of Australia and New Zealand, most of which are *classed* or graded in the shearing shed as the sheep are shorn. It seems illogical to mix all grades together, tramp the fleeces tightly into the bags, then move the clip to a handler's warehouse, where all the bags will be opened, the wool

graded, and then bagged again. However, the average size of American clips is small, and the number of shearers employed on most ranches is from one to five, while any experienced grader could easily keep up with ten. A grader's wages are high, and unless he is kept busy, his services may be too expensive. Of even greater importance is the small amount of certain grades that would be produced in the average clip. If the grower had, for example, 500 ewes of Columbia breeding, the bulk of the clip would grade 56's, but there would be some 48/50's, and some 58/60's. A few fleeces would be "offs."

Grading such a clip on the ranch would necessitate packing each grade separately. As a result, the grower would have such small quantities of some grades that he could not market them efficiently. With flocks of average size it seems more economical at present to let the handler grade the wool. With larger clips, grading on the ranch may be good practice though it has never been followed generally.

Since 1946, the U. S. Department of Agriculture has conducted a research project in several western states to determine how much preparation on the ranch, including grading, may be justified. As yet, the results do not warrant any over all conclusions.

WOOL VALUES . . . these are the things that affect the amount a grower gets for his wool

Wool values in the United States are established in Boston, Massachusetts, but are strongly influenced by wool markets abroad, particularly in Bradford, England. Western wools are quoted on a "clean basis" in Boston, while those from the Midwest and South are quoted on a "grease" basis. A thorough understanding of these terms is essential to an intelligent interpretation of a market report. *Clean basis.* This term refers to the *estimated* value of the wool when it has been freed of everything that contributes to shrinkage except normal moisture. It does not include the cost of scouring. A line of 64's combing may sell for $1.60 clean basis, but the mill buying it at that figure must then do the actual scouring. This costs 3 to 5 cents a pound, thus bringing the cost of the actually scoured product to $1.63 or $1.65. *Grease basis.* Raw wool as it comes from the sheep is called grease wool or greasy wool.

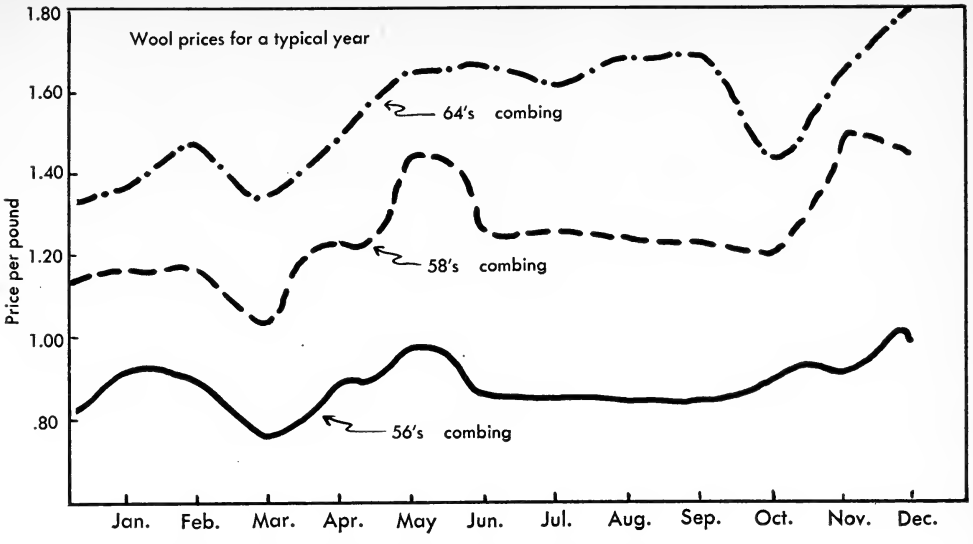
Market prices depend on:

1. Grade
2. Classification
3. Shrinkage
4. Strength
5. Purity
6. Character
7. Market condition
8. Moisture

These will be discussed separately.

1. Grade. The finer the wool, the greater is its value per pound on a clean or scoured basis. If 64/70's combing wool is quoted at $1.50 a pound on the Boston market, 56's combing will probably be quoted at $1.25, and 44's combing at $1.00. The fact that fine wool sells for a higher price does not mean that the grower's first objective should be to produce it. Many areas are better adapted for growing medium and coarse wools.

2. Classification. Within any grade, wools long enough to be called strictly combing or staple are more valuable than those of French combing length, and French combing wools are more valuable than those of clothing length. This statement is true whether values are on greasy or scoured basis. The grower should strive to get as much length of staple as possible. Staple length is an inherited



Characteristic wool prices for various grades. The difference between two grades is not always the same, but the finer grades tend to be worth more at all times.

character, although it is also influenced by nutrition and by the age of the sheep.

3. Shrinkage. The percentage of the weight of grease wool lost in the process of scouring is called the *shrinkage*. The percentage of cleaned scoured weight left after scouring is called the *yield*. Even under identical growing conditions, shrinkage varies with grade, length, and density of wool. The finer the fleece, or the shorter the staple, or the looser the fleece within any grade, the higher the shrinkage.

Shrinkage is also influenced by:

(a) The amount of natural grease in the wool. This varies among different breeds and the climates they run in. Areas of loose soil, much wind, and sparse feed produce heavy-shrinking wool.

(b) The amount of dried perspiration or suint, also affected by breed and climate.

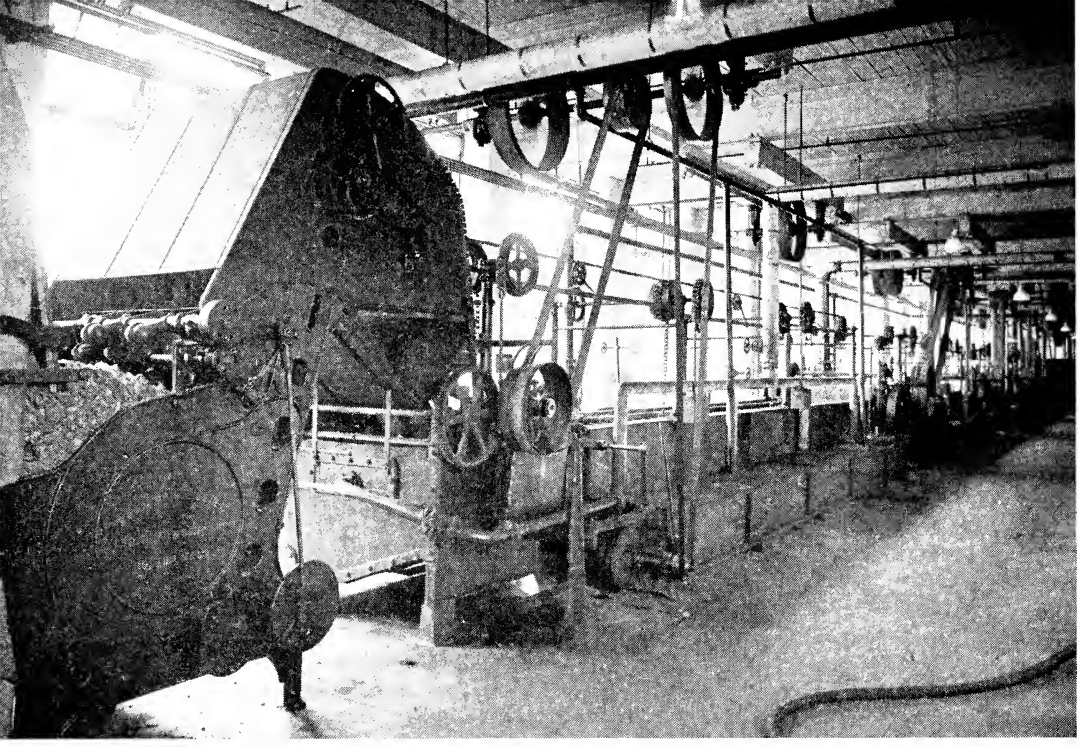
(c) The weight of dirt and vegetable matter in the wool.

(d) The amount of moisture present.

Shrinkage is the greatest single factor influencing values. It can be controlled only to a limited extent. It may vary from as little as 25 per cent in very coarse wools, grown where sheep are subjected to heavy rains over long periods, to well over 70 per cent in fine wools produced in sections of the country where sand storms are common. Unfortunately for grower and buyer alike, shrinkage is difficult to estimate accurately, even by handlers with years of experience. It may vary several per cent in the same flock in different years; consequently, a test conducted in any one year is not necessarily applicable to the next.

How is shrinkage determined? The shrinkage of most wool sold in the United States is estimated by the buyer. Young buyers are trained by older ones, who are experienced. Faulty judgment on shrinkage may be corrected by comparing the actual mill shrinkage with previous estimates. Growers seldom have access to the figures.

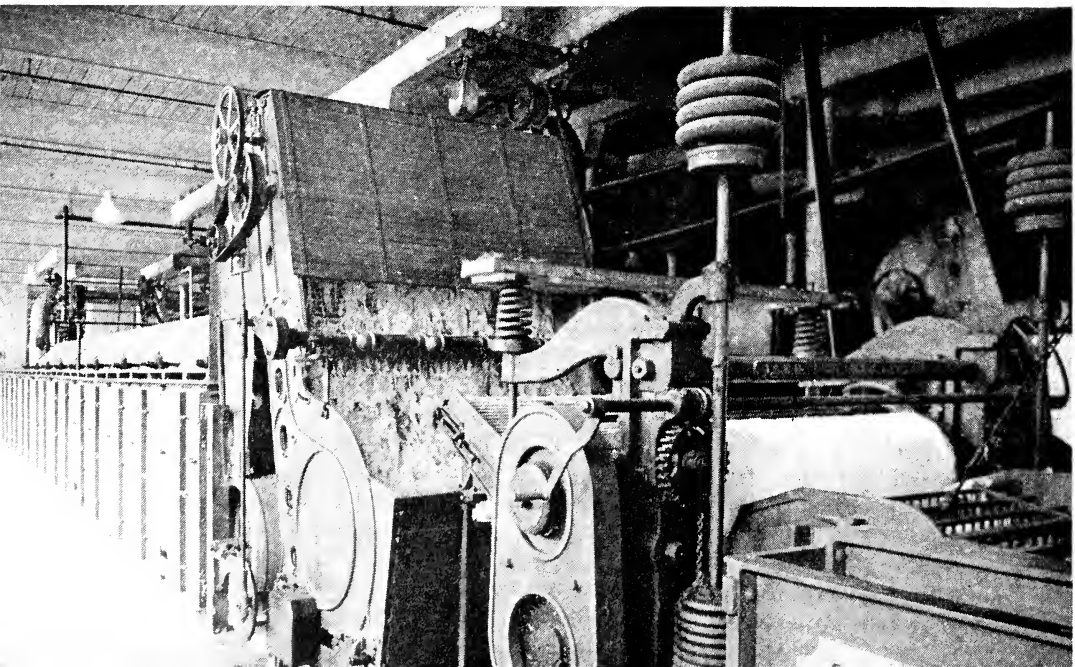
Estimating shrinkage requires long experience with the wools in the particular area where they are grown. Without such experience, a buyer who might be reasonably accurate in judging shrinkages in an area like southern Wyoming might make serious errors in the shrinkage of Texas or California wools of the same grade. Visual estimates also differ widely at times even among appraisers experi-



This photo shows wool entering the first bowl of a three-bowl scouring train. Note size of machinery required. (Photo courtesy of American Woolen Company.)

SCOURING WOOL REQUIRES VERY HEAVY MACHINERY

Scoured wool leaving the scouring train and entering the drier.



enced in a given area. This was amply demonstrated by the U. S. Department of Agriculture, when 58 clips that had been appraised for shrinkage were scoured. The results showed errors in judgment varying from more than 6 per cent above the true shrinkage to more than 6 per cent below it. Even with such gross errors, a buyer may still be a satisfactory one as far as his own profit is concerned. If he overestimates shrinkage by such a margin, however, the grower may suffer.

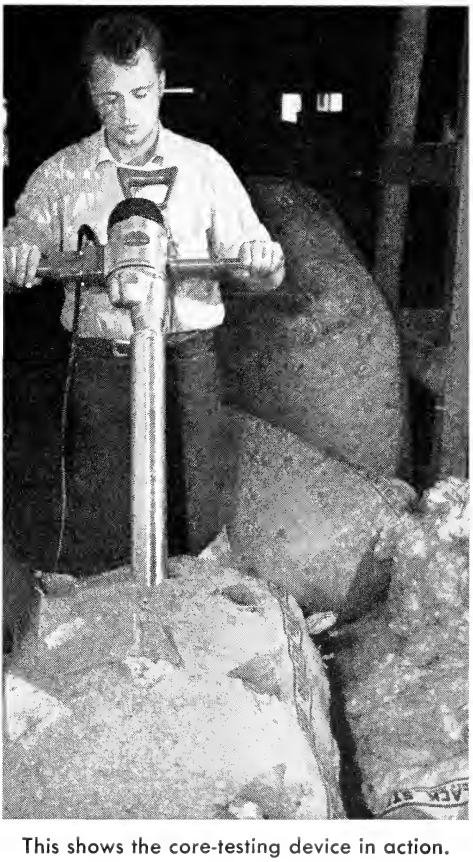
The core-test method is now widely used to find shrinkage. An increasing number of mills buy wool from dealers on the shrinkages furnished from this test. Cores or tubes of wool are extracted from the packed bag or bale and are mixed and scoured. The results obtained from scouring the cores are presumed to apply to the entire bag from which they were taken. Core tests on the 58 lots mentioned above showed that in no case did the shrinkage vary more than 2.5 per cent above or below that obtained in the mill, while in 51 of the 58 lots tested the error was not more than 1.5 per cent. It is safe to conclude that the core test provides a much more accurate means of testing shrinkage than is possible by the eye.

The U. S. Department of Agriculture has carried out more core tests than any other agency. The thousands of tests it has run were practically all in connection with the government wool purchase program during the war years and subsequently, when final settlements to growers were based on shrinkages obtained from cores. At present private agencies extend a like service, whose patronage by the grower may be of great benefit, provided the clip is large enough to warrant the cost of the test.

Core testing has been severely criticized but for the most part has withstood the criticism. Its accuracy depends largely on the evenness of the clip in grade, condition, and preparation. Obviously, if many grades are placed in a single bag and some of the fleeces carry heavy tags while others do not, a series of cores from that bag may not accurately represent the entire contents. Moreover, a loosely packed bag is difficult to core.

"How much is my wool worth?" is an important question for the grower. It faces him annually. To answer the question, he must know the approximate grading of his clip and have some idea of its shrinkage. He can then look in a trade paper for the values on a scoured basis and get an idea of ranch values. But to do this, it is necessary to memorize these simple facts:

1. Prices quoted for western wools are on a clean basis in Boston.
2. Quoted prices unless otherwise specified are for *graded* wools.
3. Quotations are those made by dealers or handlers to manufacturers.
4. The grower pays the freight to Boston.



This shows the core-testing device in action.

HERE ARE SOME SAMPLE PROBLEMS

Problem 1: The *California Wool Grower* quotes fine combing at $1.60. The shrinkage is estimated at 62 per cent. How much is this wool worth on the ranch?

Solution: If the shrinkage is 62 per cent, the yield is 100 per cent minus 62, or 38 per cent. The wool is worth 38 per cent of $1.60, or 60.8 cents. However, this value is that in Boston. From it must be subtracted total charges of approximately 5 cents a pound, covering freight, commissions, cartage, and insurance. The ranch value is therefore 60.8 cents minus 5 cents, or 55.8 cents.

By the same methods of calculation, if the shrinkage is 63 per cent, the ranch value is 54.2 cents; if 61, the value becomes 57.4 cents. From these figures, it can be seen that at $1.60 clean basis, each one per cent difference in shrinkage influences the ranch value of the wool 1.6 cents a pound. It is also apparent that the higher the value on a clean basis, the more the grease price is influenced by shrinkage.

Problem 2: A grower is offered 55 cents on the ranch for his clip. The latest quotation for that type of wool is $1.50 clean. If the offer is in keeping with the market, what should be the approximate shrinkage?

Solution: An offer of 55 cents on the ranch means that the clip will cost 55 + 5, or 60 cents landed in Boston. The next question is, "What per cent of the clean price is the grease price?"

$\frac{0.60}{1.50} = 0.40$, or 40 per cent. But 40 per cent is the yield. To get the shrinkage, the yield is subtracted from 100. It is 60 per cent. To prove whether or not the calculations are correct, it is only necessary to go back to a basic rule:

Clean value (in Boston) × yield = grease value.

The yield in this problem was calculated at 40 per cent, and the clean value was given at $1.50. Therefore, $1.50 × .40 = 60 cents, grease value in Boston, and 60 cents – 5 cents = 55 cents, the ranch offer.

Problem 3: A grower is offered 58 cents for his clip. From the best information available, the shrinkage is about 52 per cent. What is the clean value of this clip?

Solution: 58 cents + 5 cents = 63 cents, grease value in Boston. 100 per cent – 52 per cent = 48 per cent yield. 63 cents is 48 per cent of the clean value; 1 per cent of clean value is $\frac{63}{48}$ or 1.36 cents, and 100 per cent of clean value is 100 × 1.36 cents, or $1.36.

Problem 4: A grower's clip is estimated to have the following description:

(Problems based on prices prevailing about October, 1950.)

Grade	Length	Per cent of clip	Clean basis value	Shrinkage
			dollars	per cent
64/70's	staple	10	1.60	60
64/70's	French cbg.	50	1.50	63
64/70's	clothing	15	1.25	66
58/60's	staple	5	1.55	55
58/60's	French cbg.	10	1.40	57
56's	staple	7	1.20	50
offs	.....	3	1.00	53

What is the value of this clip on the ranch?

Solution: The clip consists of 10 parts (10 per cent) worth \$1.60 clean basis, 50 parts worth \$1.50, etc. Multiply each clean value by the proportion it represents:

$10 \times 1.60 =$	\$ 16.00
$50 \times 1.50 =$	75.00
$15 \times 1.25 =$	18.75
$5 \times 1.55 =$	7.75
$10 \times 1.40 =$	14.00
$7 \times 1.20 =$	8.40
$3 \times 1.00 =$	3.00
100	\$142.90

Since 100 parts (or pounds) have a value of \$142.90, each part (or each pound) is worth $\frac{\$142.90}{100}$ or \$1.429. The average value of the clip is \$1.429 a pound, clean basis.

Repeating this procedure with the figures on shrinkage ($10 \times 60\%$; $50 \times 63\%$, etc.) shows the average shrinkage is 60.94, or 61 per cent. Returning now to the solution of Problem 1 shows the grease value is $\$1.375 \times .39$, or 53.62 cents in Boston. Deducting charges of 5 cents gives 48.6 cents, value on the ranch.

4. Strength of fiber. A weak fiber may cause a fleece that would otherwise classify as strictly combing length to be graded as clothing. Such fleeces are called "tender." For a more complete description of the causes of tender wool, see page 29.

5. Purity. By *purity* is meant freedom from:

a. Stiff, hairy fibers that do not match the remainder of the fleece in diameter or appearance. These are commonly found on the crest of the neck and body folds of heavily wrinkled finewool sheep.

b. Kemp, or coarse, "dead white," opaque fibers that are pointed at both ends unless cut by the shears. They are hollow, brittle, and weak, reflect light differently from normal fibers, and in consequence appear to take dyes differently. They are considered an indication of poor breeding or a "throwback" to poor ancestors. While kemp has been almost eliminated in the improved breeds of sheep, it may be found occasionally among nearly all of them. It is common on many of the mountain breeds in the British Isles and among Cheviot sheep and Angora goats in the United States.

c. Naturally colored fibers, whether black, brown, or buff. These are very objectionable to the manufacturer because the fleeces containing them must be carefully sorted. If colored fibers are interspersed with white ones, the entire fleece is thrown in with the black wool. It cannot be used to make white goods and must be dyed black or some color sufficiently dark to hide the colored fibers. In some areas of the United States, growers use 1 or 2 per cent of black sheep for "markers."

Purity, as used in the trade, does not refer to wools damaged from branding, urine stains, or bacterial discoloration.

6. Character. This term represents the total of all characteristics that make wool attractive to the eye. The color of natural secretions and their even distribution in the lock, brightness, crimp, and sound tip are the principal ones.

7. Condition of the market. At any one time, certain grades may be in greater demand than others. When demand is good for these grades, their prices tend to rise in relation to other grades.

8. Moisture. Many growers do not realize the importance of moisture to the value of the clip. Wool has a very unusual capacity to absorb water and to give it off. In an atmosphere that contains all the water vapor it can hold, the clean wool fiber may absorb as much as 30 per cent of its own weight of atmospheric moisture without feeling damp. Under *standard textile conditions* of 70 degrees Fahrenheit and 65 per cent relative humidity, it may take up about 14 per cent of its weight.

In official tests for shrinkage, wool samples are dried before and after scouring to place all determinations on the same moisture basis. Dealings in scoured wool, combed wool ("top"), and yarn are accompanied by moisture tests to determine how many pounds shall be paid for. The higher the price, the more important moisture considerations become. Obviously, the more moisture any given raw wool contains, the higher will be its shrinkage.

While standards of moisture have been established for practically all textile fibers, it is unfortunate for the grower that raw wool as it comes from the sheep cannot have a standard. Dirt, suint, wool grease, and vegetable matter in the fleece—each has a different attraction for moisture. Since their respective amounts in the fleece are so highly variable, a standard is impractical. In spite of this fact, the moisture content of raw wool is of great importance to the producer. Though the total value of the bag remains the same regardless of the amount of moisture present, the value per pound fluctuates with shrinkage, which in turn is influenced by moisture.

In California, most clips are sold at shearing time for cash. Some sales are made in advance of shearing. The problem of the grower then is to dispose of the clip with a legitimate amount of moisture in it.

In most sections of California, little or no rainfall is expected from the middle of May until the first of October. This is

TABLE 4. Effect of Moisture Changes on the Weight, Shrinkage, and Value of a Bag of Wool Weighing 300 Pounds, with a Moisture Content of 8 Per Cent, a Shrinkage of 55 Per Cent, and a Ranch Value of 60 Cents a Pound

Weight of bag	Moisture	Shrinkage	Total value of the bag	Value per pound
	per cent	per cent	dollars	cents
287.5	4	53.0	180.00	62.2
290.5	5	53.5	180.00	61.9
293.6	6	54.0	180.00	61.3
296.8	7	54.5	180.00	61.0
300.0	8	55.0	180.00	60.0
303.3	9	55.5	180.00	59.3
306.7	10	56.0	180.00	58.7
310.1	11	56.5	180.00	58.0
313.6	12	57.0	180.00	57.4
317.2	13	57.5	180.00	56.7
320.9	14	58.0	180.00	56.1

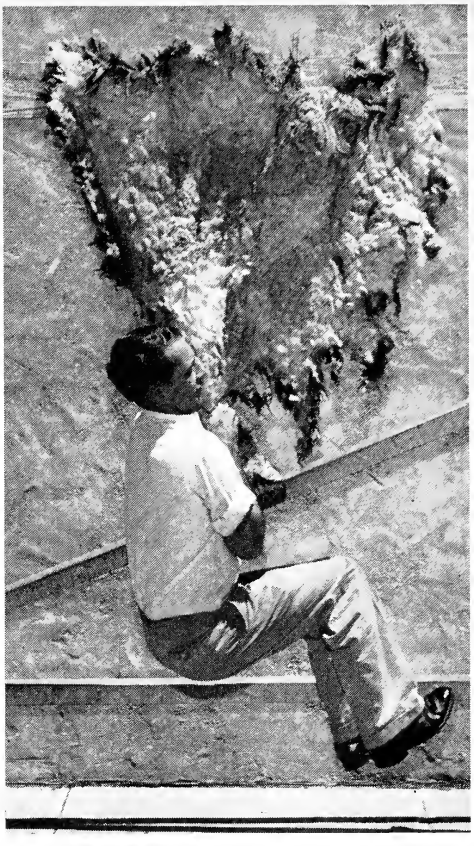
particularly true of the two great valleys where most of the state's clip is grown. If a clip is shorn in April and stored in a barn or shed on the property for any considerable time, it may lose weight.

If the bags are well packed, the loss occurs most rapidly in the areas nearest the outside of the bag. A test at the University of California showed that when a bag of wool was moved into an air-conditioned laboratory with a relative humidity of about 35 per cent, the outer 4 inches of wool leveled off at about 8.5 per cent moisture. When the rainy season approached, the bag was taken to the shearing shed, where the humidity was about 80 per cent. In three weeks the percentage of moisture in the outer layer rose to 12.5, and in two more weeks it was nearly 16. The importance of moisture may be realized from these figures: If a bag of wool weighs 300 pounds, over 130 pounds of its contents lie in the outer 4 inches.

Small flock owners in California sometimes pile newly shorn fleeces and sack them after the rush of spring work is over. This permits much freer movement of air through the wool, and during dry weather the weight lost may exceed in value the freight charges to Boston.

Cotted fleece. Fleeces so matted that the locks are difficult to open or separate with the fingers are called *cotted* and are known in the trade as *cotts*. Cotting nearly always develops during the later growth stages of the wool, when the fiber is long. It may be confined to the outer or weather end of the fleece or may affect the entire staple. In severe cases, the fibers become so felted together that the fleece cannot be broken apart by hand.

Though most common among coarsewool sheep, cotting may occur in any breed or crossbred. It is seen often among Lincolns and Cotswolds and, to a lesser extent, among Romneys grown on the northwest coast of California and in the wetter sections of Oregon and Washington, where apparently the pounding of the rain felts the outside tips of the wool.



This coarsewool fleece became so badly cotted that it would require heavy machinery to separate the fibers. The man hanging on it weighs 150 pounds.

Coarsewool sheep subjected to long periods of warm, humid weather sometimes have to be taken from the show circuit and returned home because their fleeces become cotted.

The value of a cotted fleece decreases in proportion to the extent of the defect. If severe, the fleece must be torn apart by machines that break the fiber and thus make the sorting operation impossible.

Stained wool. In the north coastal areas of California—and in other sections during seasons of high spring rainfall—portions of many fleeces become partially discolored. The discoloration is most common on the area of the withers, extending downward to the shoulders.

At times the entire back and sides may be discolored. The staining occurs in the spring when the sheep are in nearly full fleece and the weather is wet and warm. The stained areas are usually either a decided pink or green. Yellow and brown have also been observed.

Experiments indicate that *chromogenic* (chromo means color) bacteria cause the trouble and that the same kind of bacteria are responsible for all the colors found. The bacterium appears to be identical with the *pink rot organism* identified in New Zealand. It is probable that the organism is present almost everywhere but manifests itself visibly only under conditions ideal for its growth.

Ordinarily the colors are *fugitive;* that is, they wash out readily in the scouring process. They may fade almost to the point of disappearance if the shorn wools are held in storage for a few months. Buyers accustomed to handling such wools do not discount values because of the stain.

In the laboratory, the fiber of scoured and sterilized wool inoculated with the pink rot organism and held under constantly ideal conditions for approximately two weeks, will completely disintegrate into its constituent cells.

Canary stain. Though it is not common enough in California to be economically important, this bright yellow stain is permanent, unaffected by scouring. Large quantities of wool in the midwestern states are affected by it. While it is of bacterial origin, it may be brought about by improper preparation of the clip.

Operating costs. For many years, wool growers in the Sacramento and San Joaquin valleys of California derived about two thirds of their net income from the sale of fat lambs and about one third from the sale of wool. If this proportion is considered normal, it might be fair to charge all operating expenses against lambs and wool in the same proportion.

To illustrate: let us assume that it costs $12.60 a head to run a band of ewes a year. One third, or $4.20, of this expense is charged against the wool clip. Assume also that the fleeces average 10 pounds, the estimated shrinkage is 60 per cent, and the clip sells on a net basis of $1.40 clean. If the shrinkage is 60 per cent, the yield is 40 per cent, and the average clean weight per fleece is 4.0 pounds, each selling for $1.40, or a total of $5.60 a fleece. It takes 3 of the 4 pounds of clean wool to pay operating expense. $1.40 \times 3 = $4.20, this subtracted from $5.60 leaves $1.40 net profit per fleece. Now assume that the shrinkage was overestimated by 5 per cent and was actually 55 instead of 60. The average clean weight becomes 4.5 pounds, and the average value per fleece $6.30. Operating costs are the same in both cases—$4.20 a fleece. It takes the first three pounds of wool to pay the costs; the profit is in the fourth clean pound. If the clip can be sold on a 55 per cent shrinkage, the net profit is $6.30 – $4.20, or $2.10 a fleece, compared with $1.40, if sold on 60 per cent shrinkage. The difference is 70 cents a fleece, but the difference in percentage of net profit per fleece is $\frac{0.70}{1.40}$ or 50 per cent.

IMPROVING WOOL GROWTH . . . nutrition plays a major part in the formation of good wool

Given identical environments, sheep of the blackface breeds, such as the Hampshire, Suffolk, Southdown, and Shropshire, produce much lighter fleeces than most of the whiteface breeds popular in the United States. Moreover, some individuals have the capacity to produce much more wool on both greasy and clean basis than others of the same age and breed run on the same pasture.

TABLE 5. The Influence of Nutrition on the Fleece*

	Average fleece weight 6 months' growth		Average staple length	Average diameter of fiber at base	Average strength
	Grease, lbs.	Scoured, lbs.	Inches	.0001's of an in.	Grams
Good ration.....	8.62	5.88	4.3	8.4	19.4
Poor ration.....	2.51	1.84	2.5	7.0	9.4

* Romney wethers used in this experiment.

Nutrition is important. The role of nutrition in wool production is fully as important as breeding. The genetic make-up of the animal is its inherited or ultimate capacity to grow wool, but top capacity can be reached only when the animal is on a completely adequate diet.

Experiments both in the United States and in other countries have proved the very close relationship between diet and fleece production.

A trial at the University of California with wethers fed six months on a good ration and six months on a poor one that caused them to lose weight showed that the fleeces grown on the good ration were superior in every way. In addition the brightness, sheen, crimp, and "handle" of the fleeces produced on the good ration were markedly superior. At the end of the experiment, the sheep on the poor diet, however, were in a condition of thrift exceeding that of tens of thousands of California ewes in the early spring of each year.

A repetition of the experiment just described showed that a maximum quantity of wool can be had without keeping sheep on the highest nutritive plane. The chief factor, insofar as diet is concerned, seemed to be maintenance of a condition of thrift at all times without allowing serious losses in body weight to occur at any time of the year. A sheep losing weight apparently draws on its reserves of energy and fat to produce a normal fiber. But when these reserves approach the point of exhaustion and the animal is thin, all characteristics of the fleece are harmfully affected. The problem of nutrition therefore resolves itself largely into one of supplemental feeding.

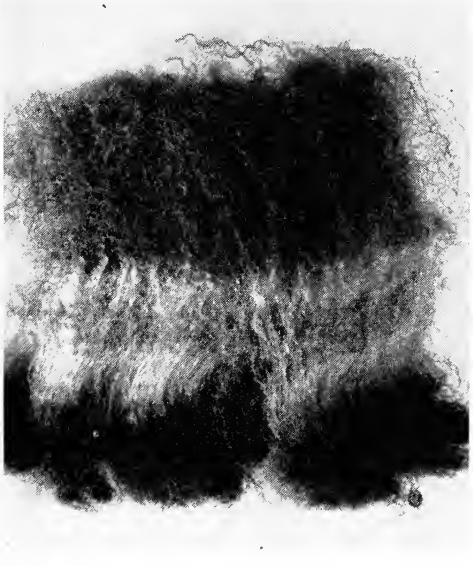
During the spring and summer months most ewe bands in California are well fed on natural forage. Over most of the state, ranges dry up in May and June. By this time the lamb crop has been sent to market. During the remainder of the summer the ewe has little difficulty in maintaining herself. Sometimes she may even get too fat. By late summer, much of the total nutrients in dry range feed have been leached out, and the ewe band—by now bred again—may go down in weight.

Many growers make the mistake of allowing this decline to continue with the idea that October rains will bring on the green grass and that thereafter the feed problem will be solved. This is a costly error. Since new green grass is largely water it is almost impossible for sheep to eat enough for proper nourishment. As a result, the ewe often drops her lamb when she is far underweight. She is then expected to draw heavily on her reserves to maintain herself during the winter. In addition, she must furnish milk for the lamb.

Some growers begin the supplemental feeding program at lambing time, giving more than satisfactory amounts of cottonseed cake, barley, or corn, and continue to feed for about 60 days, or until the green feed gets "strong." With this plan, they

waste much of the advantage in the supplemental feeding program. It requires ten days to two weeks for the sheep to become accustomed to the feed; by that time, they may be so thin that a "break" may develop in the fleece. (See "tender wool.") It is then too late to build them up to the point necessary for most favorable wool growth and milk flow. To give the supplemental feed over a long period of time is much better management than to feed a similar total amount over a short period.

To illustrate: Grower A, in Mendocino County, breeds his ewes to lamb early in February. By December the rainy season is at its height, the weather is cold, and the sheep are losing thrift. In mid-January, he starts feeding cottonseed pellets on the range at the rate of ⅓ pound a day, continuing until the end of the second week in March. Then with the lambing about over and the weather moderating, he stops feeding. The usual result—and the inevitable one in a bad year—is a heavy loss of both ewes and lambs and a poor wool clip. In all, he averages about 20 pounds of concentrates per ewe for the 60-day period.



Wool from a naturally black sheep. When the animal was given an excess of molybdenum, the wool turned nearly white; when the molybdenum was taken away, the wool became black again.

Grower B begins feeding cottonseed pellets about September 15, even though lambing is a long way off and the weather mild. He gives only 1/10 pound a day, gradually teaching the sheep to eat the supplemental feed while they are still in fairly good condition. In about six weeks, he increases the amount to ⅛ pound a day. In mid-January, he increases again to ¼ pound a day, then gradually "tapers off" to ⅛ pound, and stops altogether when the green feed gets strong. In all, he feeds about 25 pounds in comparison with A's 20 pounds. The additional amount costs about 20 cents. As a result of never being permitted to get thin, the ewes have plenty of milk for their lambs and produce a sound staple.

In broad principle these examples apply everywhere in California. In other words, it is more economical to keep sheep in good condition throughout the year than to allow them to become thin and then build them up again.

A sensible supplemental feeding program should do the following:

1. Increase the percentage of lambs saved.
2. Raise the average weight of all lambs by increasing the milk flow of the ewes.
3. Increase the pounds of wool per ewe.
4. Increase the value of each pound of wool through greater strength of fiber, longer staple, and fewer tender fleeces.
5. Decrease death losses of ewes.
6. Decrease the bad effects of both internal and external parasites.
7. Increase net profits.

The effects of nutrition on wool production as just discussed relate only to the over-all plane of nutrition. In some areas of the United States, including California, a deficiency in one or more chemical elements exists. In others, an excess of an element in the soil affects the well-being of sheep and hence the production of wool.

Left: "steely" wool (blue-white and straight) results from lack of copper in the diet. Right: adding copper to the diet restores normal color and crimp to the wool.

Trace elements. Sheep, for example, cannot thrive without the element cobalt, although the amount required may be as little as 1 two-and-a-half-millionth pound a day. Copper has also been shown to be essential. More recently, experiments in California indicate that a great excess of molybdenum in the sheep's diet will restrict the animal's ability to use any normal amount of copper present and thus produce the effect of a copper shortage. A sheep with a naturally black fleece will change to a light gray or near-white one if copper is absent from the ration, or if molybdenum is present in too great quantity. Iodine is another essential; without it, sheep develop goitre, an enlargement of the thyroid gland.

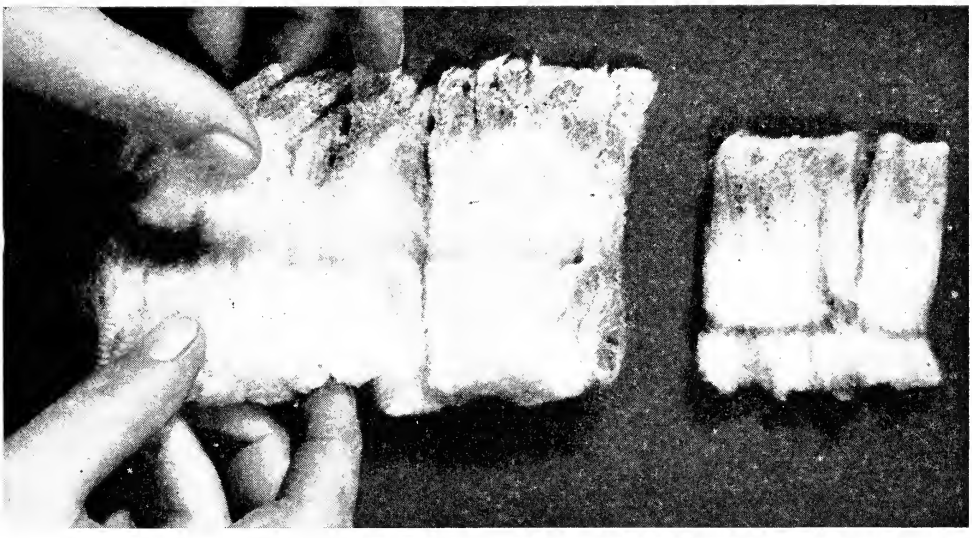
Usually only traces of these elements are necessary for adequate nutrition; consequently, they are referred to as the trace elements. Fortunately, most California soils are well supplied with the trace elements thus far shown to be essential. One limited area near Mt. Shasta has an iodine deficiency; a much larger area, lying principally in Kern and Kings counties, contains excess molybdenum.

Tender wool. When a fleece or staple of wool tested for strength shows a pronounced weakness, it is *tender* or is said to have a *break*. The belly wool is more likely to be affected than other parts, although breaks in the wool on the back and sides are also common.

In all instances of tenderness, the immediate effect is a constriction of the fiber at the point of growth. Growth of wool takes place only in the follicle, which lies below the surface of the skin. If the sheep is under any influence that will cause a break in the fiber, the result will not be visible until sometime later, when new growth has pushed the affected portion of the fiber beyond the skin surface. This may take from a few days to two weeks, depending on the rate of fiber growth.

Causes. Any marked physiological disturbance or change in the nutrition of the sheep may cause tender wool. Even fairly light upsets may produce a tenderness that sometimes can be found only by stretching a staple or lock with the fingers. If the disturbance has been severe, however, the break in the wool may be plainly visible.

a. Underfeeding. If the ration is poor during the entire growth period of the fleece, the fiber may be weak throughout its length. Fleeces showing this characteristic are only from sheep continually undernourished and are relatively uncommon. Such wools have a lifeless feeling and are dull in appearance. They may even be graded as "dead" and thrown with the offs. Usually, the tenderness does not involve the entire length of the staple but is confined to one particular point in the fiber.



Overfeeding, underfeeding, and fever are the commonest causes of tender wool. The break may occur at any time in the growth period.

This ewe had trouble at lambing and developed such a pronounced break that she lost her fleece.

b. Overfeeding. Sheep unaccustomed to a high plane of nutrition and suddenly surfeited with rich feed often develop a break. The trouble is rather common when feeder lambs are put in dry lot and given too much concentrates in the early stages of fattening, thus getting "off feed."

c. Sudden change in feed. Sheep accustomed to one feed and suddenly shifted to another may develop tender fleeces. The danger is especially great when thin animals on poor feed are transferred to good feed of an entirely different kind. As an example, 2,000 aged ewes that had run all summer on dry grass on a hill range were transported in trucks to rice stubble containing an abundance of green material. Practically every ewe in the band developed a tender fleece.

d. Sickness. Fever due to retention of the afterbirth at lambing time or to other troubles, such as garget, ulcerated teeth, a broken leg, or even an aggravated case of foot rot, may cause a tender fleece. Any prolonged illness or chronic infection may result in undernourishment and thus a break in the fleece.

Effect of tender fleece on wool values. A tender fleece is always less valuable than a sound one. The extent of reduced value depends partially on where the break appears on the fiber. If it is near the middle, a fleece that might have been classified as strictly combing will be placed in the clothing class. Its fibers will break in the combing process, resulting in excessive "noils" or short fibers. If the break is near either end, there may still be enough sound fiber of combing length for the fleece to be retained in the combing class. Most breaks in wool, however, are found near the middle of the staple, where maximum damage results.

Breeding is important too, in improving the clip from any given sheep ranch

Throughout the Sacramento and San Joaquin valleys, where about 60 per cent of the sheep industry is carried on, land values are so high that most operators in the past have not attempted to raise their own replacement ewes. Instead they ship in young ewes from other states, breed all of them to blackface rams for market lamb production, sell them at 6 to 7 years of age, and purchase more young ones to replace them. The wide adoption of this plan has contributed greatly to the poor reputation of California wool on the nation's markets.

With the serious decline in sheep numbers throughout the United States, supplies of young ewes have become scarce. The demand is heavy for them at present. This fact, combined with the difficulty of getting good stock has awakened interest in breeding replacements. A large proportion of growers in the mountainous areas of the state are already raising their replacement stock. In the north coast section, practically all ewes are being raised by the grower, because those brought in from other sections often have difficulty in becoming acclimated. Many who have tried breeding their own replacements feel the improved quality and acclimatization gained more than offset the slight difference in cost.

Selecting the breed. Adaptability of the breed to the climate is the principal consideration in deciding what kind of sheep to run. Some breeds are especially susceptible to climatic conditions. In general, the following information may serve as a partial guide:

(a) Merinos and Rambouillets are bet-

A glossary of wool terms commonly used in the wool trade, some of which are used in this circular, will be found starting on page 50.

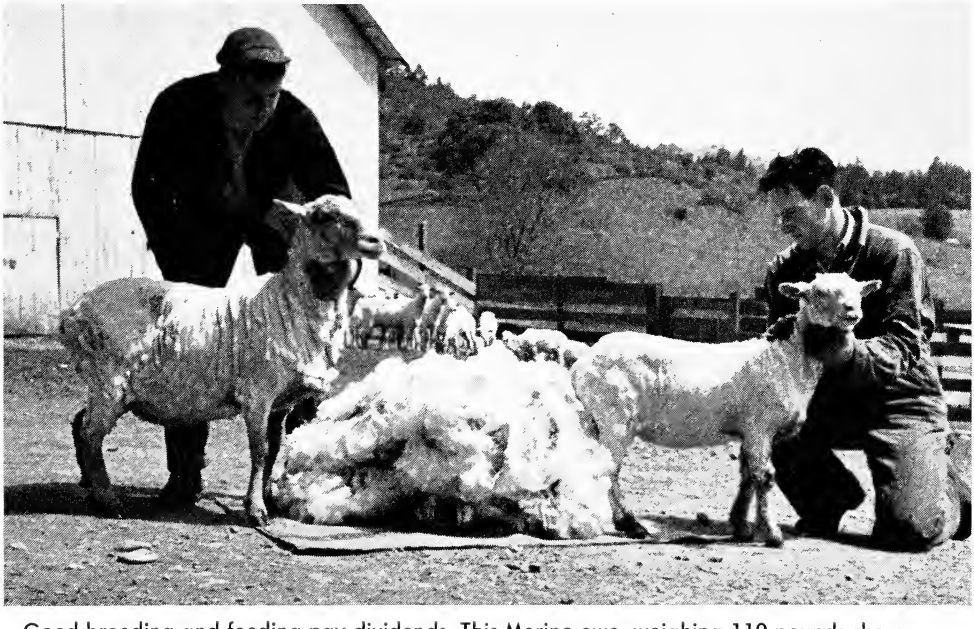
ter adapted to hard conditions of scanty feed and rigorous climate than other breeds. They possess the herding instinct more than any other. While not noted for being prolific, they breed earlier than most—an important consideration in the fat lamb industry of California. They are hardy and long lived. They produce heavy fleeces of fine wool. They are essentially "dry country" sheep and do not thrive in a wet climate, although they get along well if the wet season is not too prolonged. They are poor in mutton conformation by comparison with the mutton breeds.

(b) Longwool breeds, such as the Romney and Lincoln, are best adapted to a cool, moist climate. They are fairly hardy and prolific. These breeds cut heavy fleeces of white, coarse wool. They have little herding instinct.

(c) The blackface or Down breeds, such as the Hampshire and Suffolk, are of excellent conformation. These breeds are raised largely to secure rams, which are crossed with whiteface ewes to produce market lambs of top quality. By comparison with finewool sheep, blackface ewes are short lived, very light shearers, and late breeders. In commercial production, all lambs sired by blackface rams should be sent to market; none should be saved for replacement.

(d) Other whiteface breeds—the Corriedale, Columbia, and Romeldale—are used with great success on the better ranges and on farms where stock may be given reasonably good care. Each of these originated from crosses between finewool and longwool breeds. All are hardier than blackface sheep, cut heavy fleeces of white wool of the medium grades, are better in conformation than the finewools, and are more prolific. From the finewool side of their ancestry, they inherit a satisfactory herding instinct. If ewes are bred to rams of their own kind, their ewe lamb offspring may be kept for replacements. The wether lambs move to market at prices nearly equal to those paid for crossbred blackface lambs, although they are usually a little lighter in weight.

The lambs resulting from crosses with blackface rams grow rapidly into heavy weights and are popular with packers.



Good breeding and feeding pay dividends. This Merino ewe, weighing 110 pounds shorn, grew 16.25 pounds of light-shrinking wool, with a 4.5-inch staple, in 12 months. Her 4-month-old lamb weighed 57 pounds.

Many growers in the two great valleys prefer ewes of this type. In less-favored areas of the Sacramento and San Joaquin valleys, Rambouillet ewes, or those with a predominance of Rambouillet blood, are more commonly used.

Culling. This is the most rapid method known for improving a wool clip.

In commercial production, culling for age is an excellent practice. It not only reduces mortality on the range but increases the value of the clip. The annual wool production of an average whiteface range ewe rises slightly between the first and second years, remains fairly constant until she is about five years old, then declines during old age. The fiber may get both finer and shorter. A ewe that grows a 62's of combing length at the age of two or three may be expected to have a 64/70's French combing or even clothing when she gets old.

While no amount of culling will result in the production of a single grade of wool each year, it can, however, give greater uniformity in the clip, so that it is more attractive to buyers and can be more intelligently sold. Crossbred clips that may contain a wide range of grades and lengths can be improved by culling out the sheep with fleeces that differ markedly from the average, thus working toward an original bag clip. (See page 17.) In a mixed band the coarser fleeced sheep can be easily identified before shearing. They are shaggy in appearance and light in color.

Culling must be done in advance or at the time of shearing. The ideal method is to weigh each fleece and eliminate all ewes producing less than an established minimum. But seasonal variations among range sheep are high. To set a minimum, it would first be necessary to establish an average by weighing at least the first 50 fleeces. After that, every ewe with a fleece weight considerably under the average should be branded for culling unless her low production is known to be due to fly strike, a broken fleece, or some other definite cause. This method cannot usually be followed on most ranches, however, for the operators are too busy at shearing time to weigh each fleece.

The next best procedure is to work at the cutting chute or in a small holding pen. Here the fleece of each ewe can be opened at the shoulder, examined for length, and judged for uniformity and density. Ewes to be culled are chalked on the face and given a culling brand after being shorn. This system also permits examining the teeth and weeding out ewes with broken mouth.

Followed consistently, either of these methods will increase the average fleece weight in range bands of whitefaces two to three pounds per head. The improvement comes about simply by removing low producers from the flock and thus raising the average of those that are left.

If it is not possible to use either of the above methods, many light-shearing sheep can be identified simply by feeling the wool on the back between the hip bones. Light fleeces will usually feel thin and wasty at this point.

While culling brings about an immediate improvement in the flock, benefits to the agriculture of the country as a whole depend on what is done with the culls. If they are butchered, the entire country benefits; if they are sold to another grower who keeps them for breeding, the over-all benefits are wasted because the number of low producers has not changed.

Culling is a very slow method of improving the *genetic* or *hereditary* makeup of the flock. One investigation indicated that if half the ewes born in a flock were culled each year nearly a century would be required to improve the average weight of fleece by one pound.

If any rapid progress is to be made in improvement of a clip by breeding, the program of culling must be accompanied by the use of sires whose germ plasm is superior to that of the ewes. Sheep improvement is thus largely dependent on

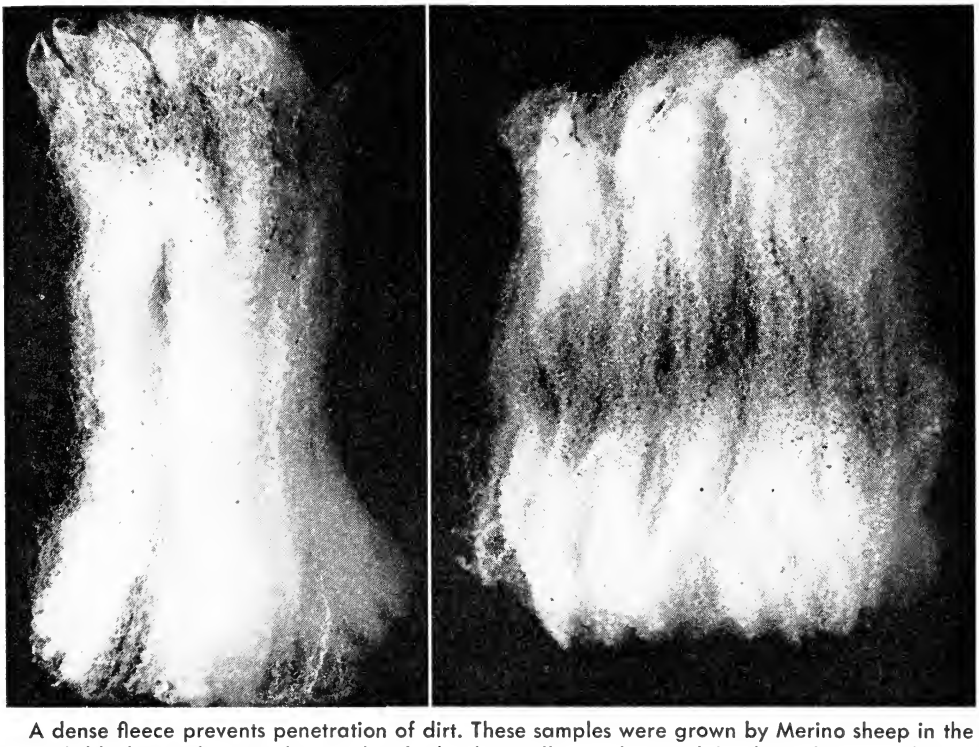
the breeders of purebred or stud stock. In California, it is common practice to use one ram to about 50 ewes. On this basis, each ram is 50 times as important to the producer as any one ewe, even though exactly half the genetic characters are transmitted by each parent. Thus selection of rams for wool improvement is the logical basis of procedure.

What kind of fleece should a ram have? Whether selecting range rams to breed to grade ewes or stud rams to be used in a registered flock, the following facts should be kept in mind.

1. The longer the staple, the heavier the fleece. Most American-grown wools, and particularly the finer grades, are too short. There is little danger for many years to come of producing rams that carry too much staple.

2. The coarser the fiber, the heavier the fleece, and the longer the staple. The quickest way to increase fleece weights by breeding is to select the coarser fleeced sheep but cull those that are rough and hairy. However, this does not necessarily mean that all rams of all breeds should be selected for coarse fiber. For maximum fleece production the ewe band should carry fleeces as coarse as climatic and feed conditions warrant.

For example, if a Columbia ram is to be used in the coastal section of Humboldt County, California, where rainfall is very heavy during the winter months, and where it is desirable that sheep dry out as rapidly as possible after getting wet, a 48/50's or quarter-blood fleece is indicated for this breed. Fleeces of this type are usually long in staple so that they will open up in a breeze, allowing air to move through the fleece and dry the sheep. On the other hand, if the Columbia is to be used in Montana or Wyoming, the ram may carry a 58/60's fleece that is shorter in staple and denser and will not open up in a blizzard to permit snow to be impacted to the animal's skin.



A dense fleece prevents penetration of dirt. These samples were grown by Merino sheep in the same fields during the growth period. Left: the dirt is all near the tip of the dense fleece. Right: the dirt line is more than halfway to the skin.

Left: a dense fleece with good lock excludes dirt, has a low shrinkage and a good appearance. Right: a loose fleece lets dirt sift in. Both sheep ran together during the entire growth period.

The lush clover pastures in central California can support the coarser fleeced ewes. They grow more wool than finer fleeced ones of the same breed and are usually larger sheep.

Growers should realize that the profit from wool does not depend so much on price per pound as on the return per fleece. Using the Corriedale as an example, one might expect a ewe on good pasture to produce about 10 pounds of 60's wool, while one with a 48's fleece should grow about 12 pounds under the same conditions. The value per grease pound for these two grades might be quite similar, the lower shrinkage of the 50's tending to compensate for the higher clean value of the 58's.

Market demand for the various grades is variable. At present (1950), the demand for 64's or finer is unprecedented. This does not mean that all growers should immediately change to finewool rams in an effort to cash in. It would take at least three generations of crossing Merinos with whiteface crossbred sheep to bring the clip to a point where the bulk of it might be called fine. Such a change would take a minimum of six years, and the grower might find a big demand for the grades he had six years before.

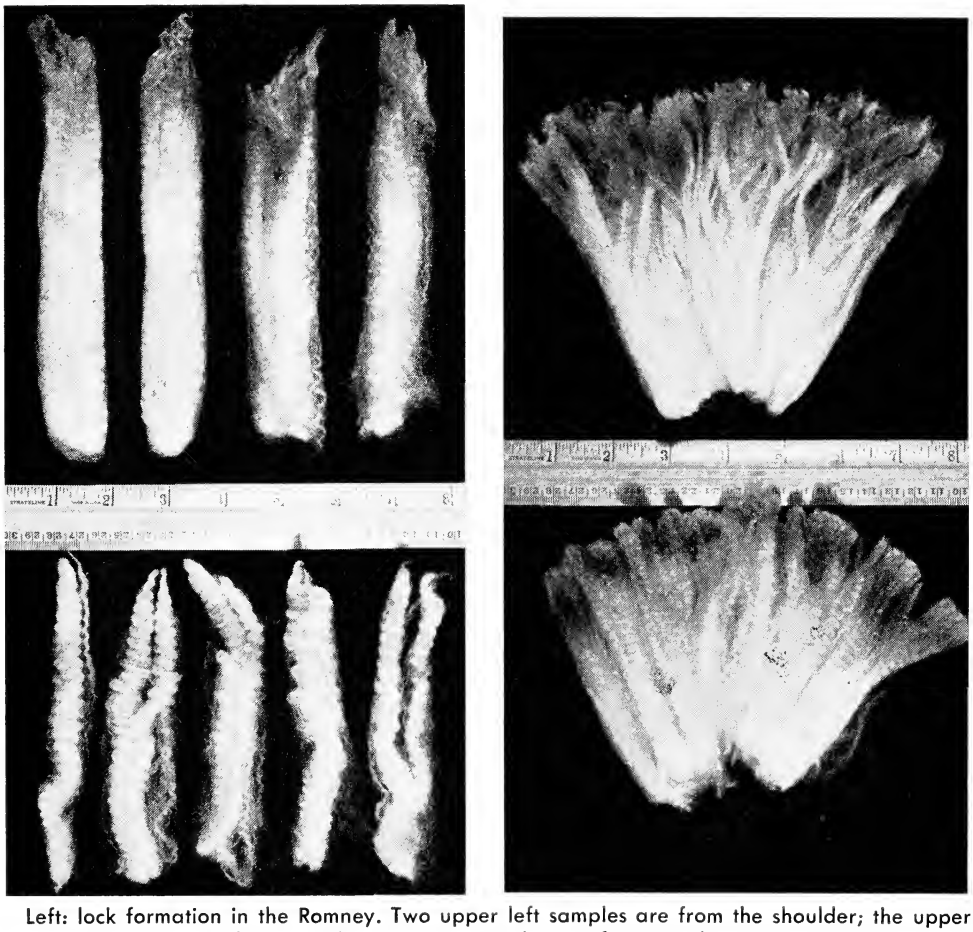
Density. In selecting rams or ewes for wool improvement in any breed, this character should not be overlooked. Density is usually defined as the number of fibers per square inch of skin surface. It varies greatly with breed, with the individual within the breed, and with the location on the animal. In loose-wooled individuals of some breeds, the density may be around 25 thousand fibers to a square inch; in the Australian Merino over 140 thousand to the square inch have been measured. The practical sheepman is concerned not so much with the number of fibers to a given area as with the total weight of wool to the same area. Weight of wool per square inch is a measure not only of the number of fibers but also of their length.

Judging sheep for density consists of feeling with the hands to determine how firm and thick the fleece is. A loose fleece feels mushy and soft. A good indication of density among finewool and medium-wool breeds is the depth of penetration of dirt, particularly on the sides and back. A fleece that is dense enough to exclude dirt from all but the tips of the locks is said to have good "closure." A loose fleece will sometimes permit the dirt to settle to the skin. Another measure of density, often used in judging finewool sheep, is the width of the line of skin that is visible when the fleece is parted with the fingers.

Lock formation. In most individuals among finewool and longwool breeds and among those derived from crosses between the two—whether ewes or rams—the fleece tends to divide itself into bundles or locks. These may vary in diameter from about that of a matchstick to that of a man's thumb. It is believed that fleece weights are correlated with lock formation, those with large locks being heavier and denser.

Size of lock varies on different parts of the body. The smallest locks are usually in the region of the shoulder blade and lower neck, the largest near the hips. In medium-wool and coarsewool breeds, they are ordinarily larger than in finewools. Some finewool sheep have locks well defined yet so small that they appear almost like needles. These are said to be "fingery." This type is almost a certain indication of lack of density.

Size of sheep. Americans want large sheep in all breeds. Criticism of either rams or ewes for being too large is almost unknown in this country. In the best fat-lamb-producing areas of California, lambs must be sent to market before the summer drought dries the feed, and producers want them to weigh at least 85 pounds live weight at five months. One-hundred-pound lambs usually bring greater profits. Such weights can be attained only by breeding large sheep.



Left: lock formation in the Romney. Two upper left samples are from the shoulder; the upper right, from the hip of the same sheep. Lower samples are from another purebred Romney; less desirable, but better crimped and brighter. Right: lock formation of Merino. Top sample is "fingery"; lower sample has a large lock, usually meaning heavy weight.

On strong land, big sheep have three advantages:

(a) They are more economical to maintain. A 200-pound animal does not need twice as much feed to maintain itself as two 100-pound animals but only 1.7 times as much as one 100-pound sheep.

(b) The cost of shearing, herding, and lambing is no greater for big than for little sheep. This is important, for many sheep operations are on a unit-cost basis.

(c) All other factors being identical, large sheep produce heavier fleeces than small ones, simply because they have more skin surface on which to grow wool.

The chief concern of the wool grower is to raise the kind of sheep and wool that brings the greatest net return. In wool production, the most important consideration is a fleece of maximum clean weight for the breed—a fleece that fills a wool bag fast. Since clean weight and grease weight have a fairly high correlation, it is reasonably safe to assume that within a breed, high grease weight means high clean weight. It has been pointed out that such fleeces are obtained by adequate nutrition and by selection for the proper fineness of fiber, length and strength of staple, density, lock formation, and size of sheep.

After the production of a "big package" has been attained, the secondary factors may be considered. The interests of the wool buyer, the manufacturer, and the grower parallel each other in many ways. The grower, however, should never forget that he is the only one primarily interested in fleece weights. The handler and the mill buy at a price per pound and thus have little concern whether the fleece weighs 4 pounds or 14. Both the mill and the handler want beautiful wools, as even as possible, and with a very minimum of shrinkage. To the grower these characteristics are secondary, even though they should not be overlooked.

How much "grease" should a fleece have? The fleece should have enough natural oil to protect the fiber from damage by the elements. Merino and Rambouillet rams usually secrete more than the ewes. In other breeds, the difference due to sex is not great.

In the belief that it was associated with greater density, early American strains of finewools were deliberately bred for high grease content. The present trend is toward less grease and a fuller-handling, loftier fleece. In fact, it is possible to breed sheep with so little grease in the wool that buyers will consistently overestimate shrinkage. The grower then may find it impossible to sell the clip for its full value. On the other hand, the grower should realize that he must pay the freight on his clip to eastern points and that the rates are applied to the grease and the clean wool content alike.

The word *grease* as applied to wool, is in use throughout the English-speaking world. Literally, the substance secreted by the sebaceous glands in the sheep's skin is a wax, not a grease.

What color should the secretions be? The color of the *yolk* (total glandular secretions) varies from near white to a dark buff color. Some strains of Merinos produce fleeces that are almost snow white; other fleeces, like Rambouillet, are usually darker. A rich cream color is to be preferred to any other. This is at least partially hereditary.

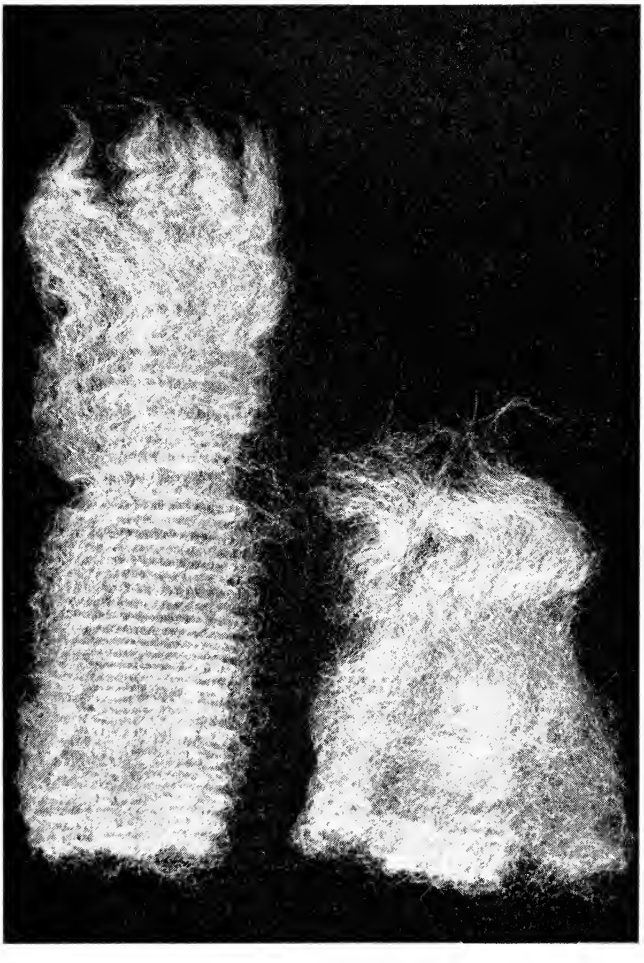
It is impossible to judge from its color the wool grease content of a fleece of raw wool either on or off the sheep's back. The color has no relation to the amount of wool grease present. It is caused by a pigment related to the bile secretions. If all the grease in a sample of wool is removed by soaking in a solvent completely free of water—ether, for example—the color of the wool remains the same. But in water the pigment is easily washed out, thus proving that the substance is not inside the fiber but only on its exterior. This pigment should not be confused with another (melanin) that causes the fleece to be black, gray, or brown.

The even distribution of the pigment

found in skin secretions throughout the length of the staple is of importance from the standpoint of appearance. When distributed as small clots on the staple, it detracts from the looks of the wool. When wool is scoured commercially, the yolk containing the pigments responsible for color is all washed out. The importance of color is, therefore, of no consequence to the manufacturer, and its value to the grower lies only in the fact that a cream-colored fleece is more attractive.

Crimp. Most of the improved breeds produce wool with a natural wave. This wave is called *crimp*. Crimp varies with different breeds, with individuals, and also with nutrition. It is markedly affected by starvation. Fine wools have many more crimps or waves per inch of fiber length than coarse ones.

Attempts to use the number of crimps per inch as a measure of the diameter of the fiber have been made but have not proved sufficiently accurate. Because crimp indicates a well-nourished and hence a strong fiber, manufacturers like it. Good crimp also means that the fiber, when straightened out, will be considerably longer than the unstretched staple. Crimp adds to the appearance of fleece but otherwise is of secondary importance.



Crimp is affected by feeding. Samples are from same spot on the same sheep, but produced a year apart. Each represents exactly 6 months' growth. Left: crimp and staple length grown on a good ration. Right: grown on semi-starvation diet.

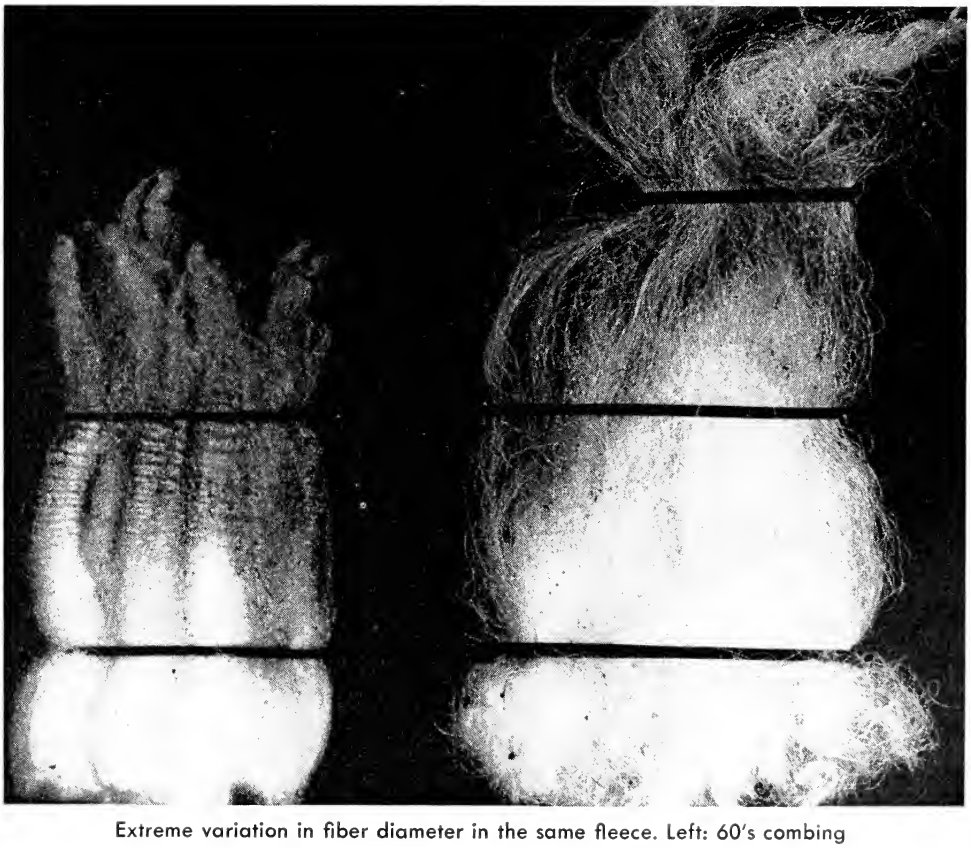
Evenness. The most important of the minor factors involved in breeding for high production is evenness of the wool over all parts of the body. The perfect fleece would be one in which every fiber had the same length and the same diameter. As yet, this perfection has never been attained. Even among purebred, registered sheep of the breeds popular in the United States, the wool on the lower thigh is nearly always coarser than that on the shoulder and neck. Among the breeds that were evolved by crossing longwools with fine-wools, such as the Corriedale and Columbia, some individuals show very much coarser wool on the britch than elsewhere. Among first-cross sheep of this breeding, the fault is often very marked. At times the wool on the britch may be so coarse and hairy that it is called "cowtail."

Unevenness tends to make the clip less valuable. The coarser parts of each fleece must be separated from the finer ones during the sorting operation, thus increasing this cost. In the selection of breeding stock, animals showing the fault should be discriminated against.

How much is a ram worth? The breeder of purebred livestock may be justified in paying a great deal more for a ram than is the range sheep producer. The ram breeder often sells the offspring of a stud ram at high prices; the commercial producer sells only meat and wool.

When the fat-lamb producer buys a blackface ram to cross on whiteface ewes, the value of the ram for such a purpose has rather definite limitations because all of the ram's offspring will go to the butcher. If the ewe offspring are to be kept for replacement purposes, the value of a range ram of the wool-producing breeds depends upon how much better his offspring are than their mothers.

Unfortunately no test has yet been devised by which one may assess in advance the breeding prepotency of a sire. Numerous tests of sires have shown a wide variation in the capacity of certain individual males to transmit one or more of their valuable characters to their lambs. For example, in a recent trial at the Texas Agricultural Experiment Station, a group of six yearling Rambouillet rams sired by one ram averaged 245 pounds in body weight and produced fleeces averaging 19.1 pounds in the grease and 9.1 pounds clean. Another group of six yearlings grown under the same conditions but by a different sire averaged 199 pounds in weight and produced fleeces averaging 14.4 pounds in grease and 6.7 pounds



Extreme variation in fiber diameter in the same fleece. Left: 60's combing on shoulder. Right: cowtail on the britch.

How much is a ram worth? This fine specimen is a Rambouillet, bred by George Beal, of Ephraim, Utah.

clean. The difference in grease weight of the fleece grown by the male offspring of these two sires averaged 4.7 pounds. On this basis it seems reasonable to assume that the production of their ewe offspring under range conditions might differ by an average of at least 1.5 pounds in the grease.

If one range ram sires ewe replacements that shear 1.5 pounds more than those sired by another ram, what is the difference in the value of the two sires, on the basis of wool production alone? Assuming that each ram will sire annually 12 ewe lambs that go into the flock and that the sire's useful life is five years, then each of the rams leaves 60 ewe offspring in the flock. If the average life of these ewes is five years, the 60 sired by the better ram will produce during their lives a total of 450 pounds more wool than the ewes sired by the poorer ram. At an average of 50 cents a pound for the wool, returns to the grower are $225.00 more with the better ram than with the poorer one.

MARKETING WOOL . . . preparation of the clip is a year-around job for the sheepman

Preparation of wool for market should include the entire growth period of the clip. Adequate care and management of sheep to grow the best possible wool is just as essential as putting up the clip in an attractive package.

Branding. Most sheep in the western states must be branded for one or more of the following reasons:

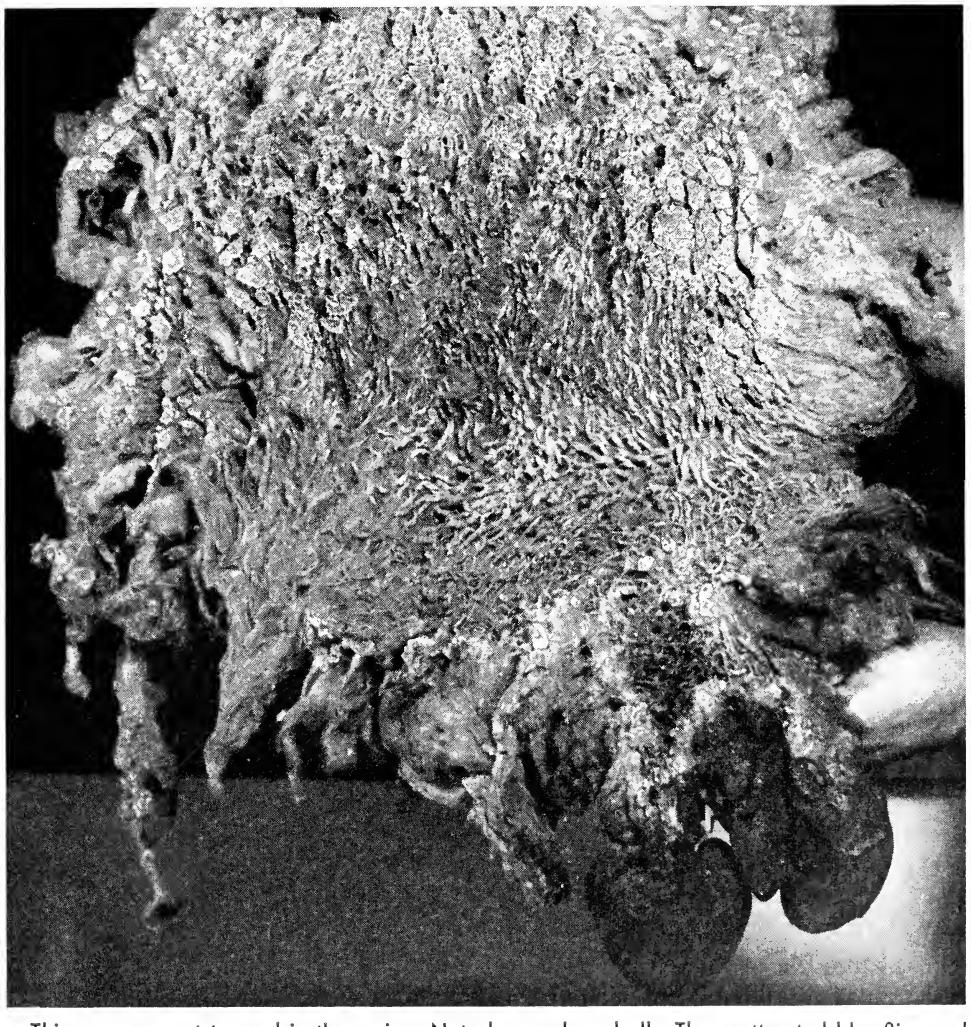
(a) Identification on ranges or forest reserves where the sheep of two different owners may get mixed.

(b) Identification with a "buck brand" at breeding time.

(c) Identification of ewes and lambs at lambing time.

Sheep-branding liquids should stay on the sheep for a year yet wash out in the normal scouring process. Thus far, no single substance has been developed that will give complete satisfaction in all climates. In the Sacramento and San Joaquin valleys, intense sunlight deteriorates paint brands much more quickly than in cooler areas where dark days are more prevalent. House paint or any other with hard-drying oil bases are insoluble in scouring and are responsible for many thousands of dollars' damage every year in the textile industry. They should never be used for branding sheep. Only marking fluids manufactured specifically for the purpose should be used, and then as sparingly as possible.

Tagging the ewes. Many California wool growers tag the ewes before the lambing season, shearing closely the wool on the udder and around the external genitals. This practice enables lambs to nurse better and also prevents the collection of heavy dung locks, which adhere to the buttocks or tail head on untagged



This ewe was not tagged in the spring. Note heavy dung balls. These attracted blowflies and the sheep was fly struck. The larvae crawled over the ewe's back, ruining a large part of her fleece. It's a wonder she lived.

ewes and greatly increases the chances of fly strike on the animal.

In the fat-lamb-producing areas of the state, tagging is done before lambing in October and November. Between this time and shearing—usually in April and May—the sheep may again accumulate filth if they are on lush green feed. The better the feed, the worse the problem of dung locks becomes. Solano County medium wools rank with the best grown in the state, but often carry excessive tags.

If sheep are shorn with fresh dung locks adhering to the fleece, the wool surrounding them becomes stained when the fleece is tied. This stain is permanent and thus reduces values.

The best operators corral their sheep on the way to the shearers and clip off the dung locks in the corral. This practice of tagging with hand shears just before shearing is strongly recommended. Usually only a small percentage of the ewes in the flock will need it.

Shearing sheds. Shearing should always be done in a clean place. Most of the larger range flocks in California are shorn either in sheds designed for the purpose or in large portable outfits owned by shearing contractors. Too many farm flocks are shorn in barns or sheds where straw and chaff may get mixed with the wool.

A clean board floor should always be available. In a properly designed shed, both the catch pens and the holding pens have slatted floors that permit droppings from the sheep to fall between the slats to the dirt floor below.

Second cuts. When the shearer must go over the same part of the sheep twice in order to cut the wool close to the skin, he cuts the staple in two. The short fibers shorn at the second stroke are called second cuts. These are worthless for worsted manufacture. The value of the fleece is reduced too, because the average staple is shorter than if the full length had been obtained with one cut. Furthermore, the second cuts in worsted manufacture are combed out and become what are known in the trade as noils.

The shearer cannot be expected wholly to avoid second cuts, especially when shearing heavily wrinkled finewool sheep, but he should be encouraged to eliminate them as much as possible. The extent to which both machine and blade shearers make second cuts depends partly on the type of sheep being shorn, but mostly on the skill of the individual workman. If every shearer could have experience as a wool sorter and see the damage done by carelessness or lack of skill in shearing, the quality of work performed in American shearing sheds would be greatly improved.

Tying the fleece. Only paper twine made expressly for the purpose can be recommended for fleece tying. Other twines, such as sack-sewing and sisal twine, made of vegetable material, are not smooth surfaced. Small fibers from them become mixed with the wool when the fleece is untied. Wool is an animal product; twines are usually vegetable products. The two types require different processes of dyeing. When cloth is made from wool containing vegetable fibers, subsequent dyeing fails to color the vegetable portion. So serious is this question that most mills employ operators to extract the undyed vegetable fibers from the woven cloth and to insert, with a threaded needle, lengths of wool yarn.

It is not necessary to tie fleeces of lamb's wool. The staple of a lamb shorn at six months is so short that bringing the fleece off in one piece is impossible. Lamb's wool may be tramped into the bag in bulk.

Sacking. The following rules should be followed, regardless of the size of the clip:

1. Use only new wool bags, if possible. Secondhand bags not only detract from the appearance of the clip but, even more important, may tear just when nearly full, resulting in loss of the bag and the labor.

2. Tramp the bag firmly so that it can be handled properly. A loosely packed bag may be so limp that the work of handling it is doubled.

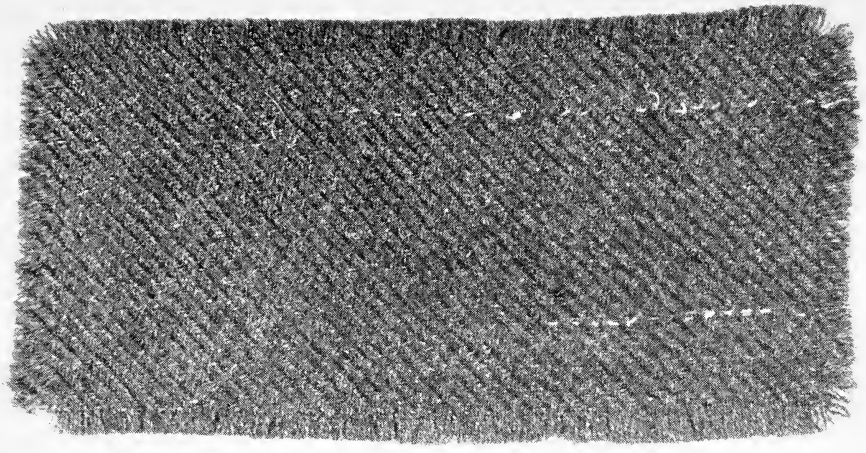
3. Do not attempt to fill the bag too full. Any unusual weight may be interpreted by a buyer as due to high shrinkage of the clip, with consequent lowering of price.

The number of fleeces that should go into one bag naturally depends on their size, but the average is about 35. A well-packed bag of finewool shrinking 55 to 60 per cent should weigh 250 to 300 pounds. A bag of medium wool should weigh 210 to 250 pounds.

4. Pack all ram fleeces separately. This is especially advisable for fleeces from finewool rams. The shrinkage is higher than for ewe fleeces. Moreover, blackface rams nearly always have black fiber around the head and legs.

5. Pack separately all black or gray fleeces and any others that have excep-

A good shearer makes a minimum of second cuts and brings the fleece off in one piece, except for the belly.



Fibers of sisal got mixed with this wool and ruined the cloth. Binder twine should never be used for tying fleeces.

tionally bad color, are cotted, or show undesirable character. All black and gray fleeces should be put aside to be packed at one time. If possible, all black sheep should be legged out and shorn by one person. The shearing board should then be swept clean to free it of black fiber.

6. Pack separately the fleeces from yearling ewes. Under identical growing conditions, yearlings produce longer stapled fleeces with a lighter shrinkage than mature ewes and their wool is more valuable.

7. Pack lamb's wool separately. Its short staple, shrinkage, handling quality, and the uses to which it is put are entirely different from those of the wool from mature sheep.

8. Even though the sheep are tagged just before shearing, a considerable quantity of sweatlocks from the region of the elbows and flanks of the sheep and wasty bits from the inside of the hind legs will accumulate on the shearing board. These are very high in shrinkage. Put them in with the tags.

9. If the clip consists of only a few bags, the total number of black, stained, blackface rams' fleeces, and "dead." may fill only part of a bag. If these "offs" are to be packed in a bag containing ewe fleeces. use a grain sack opened to form a sheet to keep them separate.

10. As each bag is filled, sew it with heavy cotton or jute sewing twine made for the purpose. Leave enough room for the top edges nearly to meet when the sack is sewn.

11. Label each bag to denote its contents and the grower's name or ranch insignia.

12. Store the clip in a good place, out of the weather, and where it will not lose too much weight.

Sorting of wool is done by the manufacturer— not by the grower or wool merchant

After purchasing a lot of graded wool from the dealer, the manufacturer puts each fleece through the "mill sort." This consists of untying it and separating it into its various qualities—a process not involved in grading. The difference between grading and sorting is shown in table 6.

Since sorting must be done before the wool is scoured, the kind of goods to be made determines the care to be taken while sorting. Since the dealer in whose

warehouse the wool is graded does not often know in advance to whom the graded lots will be sold, and since he does not know the kind of goods for which the wool will be used, the sorting and blending of most wool must be left to the manufacturer.

Cost of sorting varies with the evenness of the fleece over all its parts and also with the preparation of the clip for market. A poorly prepared and poorly grown lot of *graded* wool may cost five cents a pound more to sort than a well grown and well prepared clip. In the end this difference is, and should be, taken from the grower's returns.

Why not scour all wool grown in the West before it is shipped and thus save freight on the grease and dirt? At first glance, it seems illogical to grow in the West most of the nation's clip and ship it across the continent—where the industry is centered—with 55 to 60 per cent of its weight in yolk and dirt, nearly all of which will be wasted in scouring. Except for the "offs," the practice has proved uneconomical. If this were not true, Australia, New Zealand, and Argentina—the three largest wool-exporting countries in the world—would not send their clips half way around the globe in the grease.

No mill in this country makes all kinds of wool goods. Certain mills only comb wool into "top," others only convert top into yarn, and still others buy yarn to weave or knit into finished goods. Even the "vertical" mills that take raw wool and convert it into finished cloth make either "woolens" from fleeces too short to comb economically or "worsteds" from combed wool. A single mill does not make both woolens and worsteds. Therefore, sorting must be done before scouring.

The short, heavy, clothing wools and the wools so infested with burs and seed that they need carbonizing may be scoured before being sold to the mill, however. Most of these come from the fall wools produced in the interior valleys. Portions of fleeces from the spring

TABLE 6. Comparison of the Results of Grading and of Sorting Wool

Results of grading 5 bags of wool from a grade Merino flock		Results of sorting a bag of graded 58–60's strictly combing wool	
Grade	Amount	Sort	Amount
	pounds		pounds
64's–80's (fine) strictly combing	130	Regular sorts:	
64's–80's (fine) French combing	472	58's–60's (½ blood) combing	144
64's–80's (fine) clothing	234	58's–60's (½ blood) French combing	60
58's–60's (½ blood) strictly combing	458	58's–60's (½ blood) clothing	22
58's–60's (½ blood) French combing	208	56's (⅜ blood) combing	5
58's–60's (½ blood) clothing	60	Off sorts:	
56's (⅜ blood) strictly combing	28	Tar (paint clips)	1
		Black-gray	2
		Fribs	3
Total from five bags	1,590	Stain	13
		Shorts	1
		Tender	2
		String	2
		Total from one bag	255

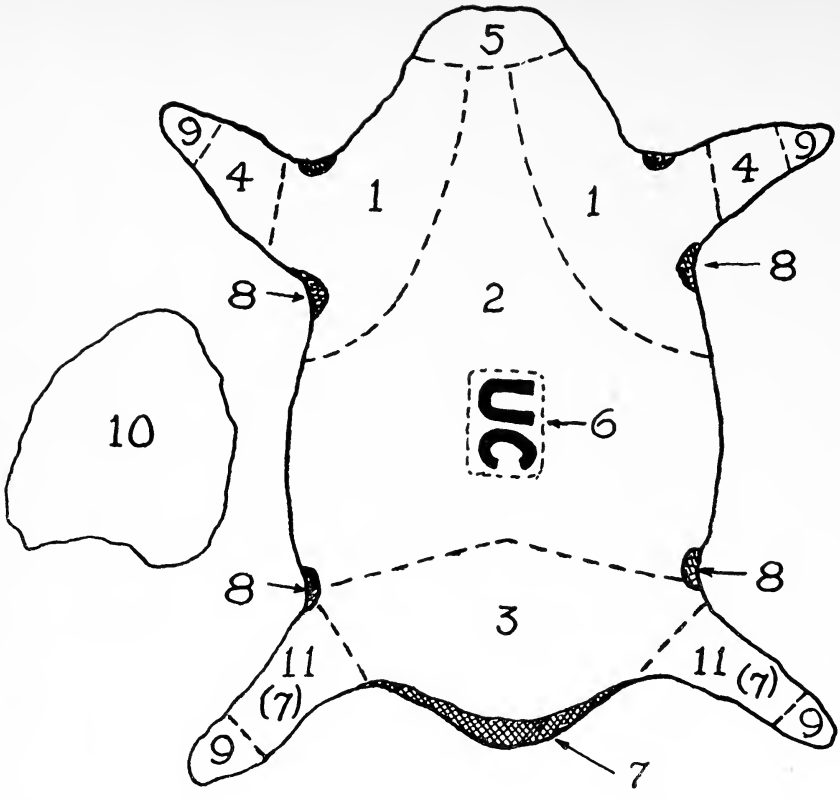


Diagram of a shorn fleece, showing the various qualities often found in a single fleece. 1. 56's (⅜ blood) combing, shoulders and neck. 2. 56's, combing, sides and back. 3. 56's or 50's, combing, rump and hips. 4. 56's clothing, forearms. 5. 58's or 56's clothing, head. 6. Tar brand. 7. Stained britch and lower thighs. 8. Sweatlocks, flanks, and armpits. 9. Shanks, lower, hairy parts of legs. 10. Seedy, belly. 11. 48's clothing, lower thighs.

clip—which is freer from seed, longer in staple, and better in character than the fall clip—are also often defective and may be scoured, carbonized, and blended in plants on the Pacific Coast before being offered for sale. Dealers commonly open fleeces of this description, separating the "free" wool (free from burs) from the "defective" (burry). The free portions, especially those of combing length, are baled and shipped to the manufacturer in the grease, to be sorted and scoured at the mill, while the defective and off sorts may be scoured and carbonized locally.

Blended wools. To get a product uniform year after year, mills like to blend wools produced from different areas. They may find, for example, that a good line of 14-ounce gabardine for men's suits can be made from California 64's combing and Big French produced in the Bakersfield area of California. But experience has shown that on account of variable feed and weather conditions these wools may be much better in one year than in another in different sections of the country. The manufacturer has found that he can compensate for these unforeseen conditions by blending a certain tonnage of California 64's with wools of the same grade from Wyoming, eastern Washington, Texas, and New Mexico. By doing so he can get a product whose behavior throughout all the many steps in conversion can be accurately predicted in advance.

With the increasing population on the west coast, California will eventually have a wool textile industry of her own. When it is established, however, blends of California wools with those from other states will still have to be made.

Buyers, wool merchants, coöperatives—all play an important part in wool marketing

Why the grower does not sell directly to the mill. Very few textile mills purchase directly from the grower. A mill usually wants to buy at one time more wool of certain grades than is contained in any one clip. For example, a manufacturer may receive an order for cloth requiring 50,000 pounds of 58/60's or half-blood combing. If wool is purchased directly from growers, the mill may get the requisite quantity of half-blood combing, but since the clip is not graded on the ranch before packing, it will also contain fleeces of other grades, some offs, tender fleeces, and the like—none of which he wants. To get graded wools, therefore, the manufacturer buys through some agency, dealer, or coöperative concern that does the grading.

The local buyer. A wool merchant cannot travel about buying small lots amounting to only a few bags each. For small farm clips, he therefore depends upon a local buyer, who usually operates in one particular locality and purchases small clips that the growers wish to sell for cash. His commission is based upon the number of pounds he secures. He may purchase for himself as well as for the merchant whom he represents. He needs little knowledge of wool values, for the merchant sets the price he may pay. The local dealer will probably buy as much wool—or more—with a value above the established price than he will buy with a value under that price. Thus, the tendency in California is to pay a flat rate in each locality, although certain clips known individually to the merchant may sometimes bring prices differing from the average.

The policy of "average" price setting in each locality as a basis for local-dealer purchases causes some small clips to sell for more than they are worth, and others—the best ones—to sell for less than their true value. Under such a system of marketing, the grower has no incentive to improve either the quality of his product or its preparation for market.

The wool merchant. The wool merchant, or wool dealer, handles most of the United States clip. He owns or rents warehouse space, buys large quantities of wool either for speculation on his own account or as a manufacturer's representative. He may grade the so-called "grading clips" (clips of widely mixed grades) in the warehouse or may even partially sort some wools by removing short and seedy portions to be scoured and carbonized locally.

Because of recent trends in the wool-textile industry, mills no longer buy huge quantities in advance of orders but get the orders first, then look for the wool required to fill them. This policy has markedly affected the dealer whose business—once almost altogether speculative—now is largely made up of buying on order from mills.

The mill order may ask the dealer for 250,000 pounds of 60's staple to be delivered at a cost not to exceed, say, $1.45 "clean landed" (in Boston). He may partially fill this order by buying from the grower original bag clips that have a very high percentage of the grade desired and complete it with graded wools from his own warehouse.

The change in buying policy is beneficial to the grower. The dealer still tries to purchase as cheaply as possible, but since he is buying on order from a mill

he is often willing—if the grower is a good salesman—to pay on the merits of the clip, with shrinkage a major factor. More growers than ever before are therefore being paid for what they actually produce.

The dealer performs a valuable service to industry. While the prices he offers may or may not be as high as those that can be obtained through other channels, he pays spot cash on delivery. Often he contracts clips in advance of shearing and makes a substantial deposit to bind the bargain. In paying cash the dealer assumes all risks of the market.

Selling on commission. A few California clips are sold on commission. In this state the leading firms handling wool on commission are also wool merchants. Some firms, particularly in the eastern states, have conducted the business solely on this basis. Under this plan, the grower may give the handler permission to use his judgment in selling or may require him to get offers for the wool and submit them for approval. Even though sound in theory, the plan has not been popular in California.

Coöperative wool marketing. The wool grower probably knows less about the factors affecting the value of wool than the producer of any other commodity knows about those affecting his crop. He lacks both the time and opportunity to acquaint himself with all these factors, some of which require years of study and experience.

Attempts to remedy this situation have led to the organization of coöperatives on the basically sound premise that through unified effort the growers can employ salesmen who know as much about wool as the dealer. In a literal sense, coöperative agencies include only those equipped to perform every service necessary in grading and preparing wool and in distributing it to mill customers. Most of the early coöperatives failed, but today a number of successful ones in Ohio, Massachusetts, and Oregon handle a large tonnage and exercise considerable influence on the market. All of them are owned and controlled by growers.

A coöperative cannot promise a grower larger returns than he could obtain privately. It can only assure him that his clip will be sold for its full value at the time of sale, which may be two months to a year after its receipt. The average grower who patronizes a coöperative gauges the success of his undertaking by a single unit—the price he actually gets as compared with the price he could have got at shearing time. Market quotations may decline seriously before the coöperative receives and prepares the wool for sale. The return may be completely in line with market quotations at the time the wool is sold, three months or eight months after the clip left the ranch, yet if it could have been sold at shearing time for more money, the average grower considers his dealings with the marketing agency a failure.

Consignment of California clips to cooperatives has not proved generally popular, although the Pacific Coöperative Woolgrowers in Portland, Oregon, has numbers of satisfied customers in the northern counties. Thus far, the bulk of the California clip, and particularly fall wool, lamb's wool, defectives, and the heavier-shrinking types, seems to bring better returns through experienced dealers.

Wool pools. Selling through wool pools is a modified form of coöperative marketing. It is coöperative in the sense that numbers of growers band together for the sole purpose of getting a better price with the increased tonnage. Some California growers engaged in the poultry business keep as few as 10 sheep; some fruit growers in the foothills of the Sierras keep 25 to 100. The expense of calling on such growers is too great to warrant the payment of full market values by any primary wool dealer. As a result, these small lots are often sold far below market values. Experience has

shown that a pool of small clips may bring together an amount of wool that will justify the attention of dealers. At times, a pool has brought as much as seven cents a pound above prices being paid through individual sales.

The more successful pools in California have been organized through the County Farm Bureau. After the shearing season, the various clips are assembled on a predetermined day. Dealers bid on the entire pool as a single lot. Returns are prorated. In some instances, sealed bids have been required. This method of selling appeals strongly to small producers, because prices are better than from private sale and the returns are almost immediate.

The plan has one disadvantage: all the clips, good and poor, are sold as one lot, thus in effect causing the better clips to hold a price umbrella over the poor ones.

The real solution would be to grade the pool before it is sold, but the cost of doing so would be justified only if a minimum of about 2,500 fleeces were brought together. A partial solution may be had by weighing the fleeces and splitting the pool into two parts. One lot would consist of all fleeces weighing less than a certain poundage, the other, of all fleeces over it. If the area included in the pool has clips averaging about eight pounds, from well bred and well cared-for sheep, setting apart all fleeces weighing less than five pounds will catch those from poorly bred and semi-starved animals. If the two lots thus divided are sold separately, the better lot will bring a higher price both per pound and per fleece. This plan necessitates considerable voluntary labor on the part of the committee in charge, for bags must be opened, each fleece handled, and all "suspects" weighed. The bags must then be resewed and the pool bagged again. Extra bookkeeping is required.

The most successful pools are those in which the size of the clips consigned is large enough to permit each to be sold separately by sealed bid. The pool then serves its patrons simply by concentrating a large amount in one place, making it easy for buyers, and attracting more competition among them.

The wool pool, under any plan that fits the needs of the area served, seems to be the best means for disposing of small clips in California. If the amount of wool consigned is large enough, the pool assures the interest of primary handlers. The plan also appeals to the grower, because returns are quickly made. The principle of having sales controlled by those who grow and own the wool is one of the most attractive features of the wool pool.

California and the entire United States needs all the methods of wool marketing now at the disposal of growers. Each plan has its place and under certain circumstances each is best for the producer. The sum of all the methods provides a system of checks and balances that has been recognized as desirable not only in merchandising all commodities but also in the basic organization of the American Democracy.

Coöperative Extension work in Agriculture and Home Economics, College of Agriculture, University of California, and United States Department of Agriculture coöperating.
Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914.
J. Earl Coke, Director, California Agricultural Extension Service.

GLOSSARY OF WOOL TERMS

Not all the terms listed below are used in the text. Some are included as an aid in interpreting market reports and articles on wool.

Apparel wool: Suitable for making clothing or apparel, as distinguished from carpet wool.

Baby combing: See French combing.

Big French: See French combing.

Blending: Mixing two or more lots of sorted grease wool previous to scouring; mixing wool and cotton, shorn wool and shoddy, etc.

Braid: Seventh and coarsest of the United States grades of wool under the old system of naming the grades.

Break: Weak place in a fleece or staple of wool caused by malnutrition, overfeeding, or fever.

Britch wool: From the lower parts of the thighs, often coarse and hairy.

Carbonizing: The process of removing by chemical means the vegetable matter from wool.

Carding: A manufacturing process that converts loose scoured wool into a continuous strand suitable for subsequent operations.

Carding wool: Short wool suitable for woolen manufacture.

Carpet wool: Coarse, hairy wools used in making floor coverings.

Character: Crimp, handling qualities, and general appearance.

Classer: British equivalent of a wool grader.

Clean basis: The price based on what the wool will cost when scoured, but not including the cost of scouring.

Clothing wool: Too short to comb economically.

Combing: Manufacturing process that removes short fibers.

Combing wool: Long enough to comb on the English or Noble comb.

Common: Sixth and next coarsest of the American market grades (old nomenclature).

Condition: The amount of yolk or dirt in grease wool. Wool is heavy conditioned if it contains large amounts, light conditioned if it contains small amounts.

Cotted: Matted or felted before being shorn from the sheep.

Cowtail: Coarse, hairy wool growing on the lower thigh of a sheep with a fleece whose other parts have none.

Crimp: Natural waviness of the wool fiber.

Crossbred: In the United States a wool from a crossbred sheep, usually longwool × finewool. In Great Britain and the Dominions any wool that is not Merino.

Dead: Showing a complete lack of character and life, even though it may have been shorn from a living animal.

Defective: Burry or seedy.

Fall wool: Shorn in the autumn. In California it usually is of four to five months' growth.

Fine: First of the United States market grades. Also wool of small fiber diameter.

Free: Free of vegetable defect. In a wool market report "f." or "n.f." means free or nearly free.

French combing: Too short to comb on the English system but long enough to comb on a French comb. Big French means the staple is near the upper limit for a French combing.

Fribs: Small, greasy, and heavy conditioned locks of wool.

Frowzy: Feeling exceptionally thin and lacking character.

Grade: Average diameter, expressed in arbitrary terms, of the fibers in a fleece.

Grease wool: Wool as it comes from the sheep.

Half-blood, three-eighths blood, etc.: Names of official grades.

Handle: Wool with a good handle has a "kindly" feeling and the characteristics of superiority.

Hank: Unit of measurement of yarn in the wool textile industry; in worsted yarns, on which the spinning counts and hence the names of the grades are based, the hank is 560 yards.

Hoggett or hog: British term meaning yearling; thus, ram hoggetts and ewe hoggetts.

Hungry wool: Starved appearance and feeling.

Hygroscopic: The capacity to absorb (and to give up) moisture.

In bond: Imported wool impounded by the federal government pending the payment of customs duties or tariff.

Kemp: A white, opaque, weak and brittle fiber found in some fleeces of wool and mohair. It will not take dyes as wool does and has little value in manufacturing.

Keratin: The protein substance of which wool, hair, horns, and hooves are largely composed.

Lanolin: Purified wool grease. It is used as a base for high-grade salves and ointments, in cosmetics, and for other purposes.

Line fleece: One whose diameter of fiber is midway, or on the line, between two grades.

Lock; lock formation: A natural grouping of the fibers in a fleece into small units or bundles.

Locks; dung locks: British Empire synonym for tags.

Lofty: Wool that is full of life and shows many of the characteristics of the ideal.

Longwool: From the longwool breeds of sheep—Lincoln, Leicester, Romney, Cotswold, etc.

Low: Coarse, usually 46's or below.

Luster wool: Practically the same as longwool.

Medium wool: Medium fineness of fiber.

Mohair: Fleece of the Angora goat.

Noils, noil: Short fibers removed in combing.

Offs: Undesirable fleeces that do not match the characteristics of the bulk of the clip; i.e., badly stained, dead, black, etc.

Off sorts: The portions or sorts of a fleece that are less valuable than the main or regular sorts in the same fleece because of paint brands, stain, etc.

Pieces: Small portions of fleeces that become detached from the main portions in shearing. They are graded for quality by the "piece picker," baled and sold separately. The term is used on British Empire wool markets.

Preparing wools: Long stapled coarse wools.

Pulled wool: Removed from the pelts of slaughtered lambs and sheep.

Purity: Absence of fibers other than white.

Quality, quality number: The grade of the wool under the spinning-count system; degree of fineness.

Raw wool: As it comes from the sheep.

Run out: A fleece runs out when the britch is much coarser than the shoulder and sides.

Sack-burned: Stained a permanent bright yellow by bacterial action when wool is packed too moist and stored in a warm place. The same discoloration may occur on the sheep.

Scoured: Washed to remove yolk, dirt, and other natural impurities.

Second cuts: Short bits resulting from passing the shear twice over the same area in an effort to get close to the skin.

Seedy: Containing excessive seed or chaff.

Shanks: Wool from below the knees and below the hocks.

Shearling: In the United States a shearling is a pelt taken from a sheep or lamb shorn one to three months before slaughter. Used for lining sheepskin coats.

Shoddy: Fiber recovered from wool rags.

Shorts: Small, short bits of wool that accumulate in the process of sorting.

Skirting: British Empire term describing the separation of less desirable from the more desirable parts of a fleece. Skirting is done in the shearing shed by a "skirter."

Shrinkage: Percentage of the weight of grease wool lost in scouring.

Sorting: Separating the fleece into its various manufacturing qualities.

Soundness: Strength.

Spinning counts: Arbitrary numbers, such as 40's, 56's, 70's, denoting the degree of fineness of the fiber.

Spinners wools: Best of the finer grades of strictly combing wools.

Spring wool: Shorn in the spring of the year in those sections where twice-a-year shearing is practiced.

Stained: Colored from contact with manure or urine, or by bacterial action.

Staple: A lock or small sample of wool from a fleece.

Staple wools: Those that more than meet the minimum length requirements for a combing wool.

Strongwool: British Empire term meaning coarse for the breed. A sheep of any breed with a fleece coarser than average is strong. Australian Merinos are sometimes divided into three categories—finewool, medium wool, and strongwool.

Stubble shearing: Shorn with the blades at some distance from the skin to prepare sheep for show or shipping to a different climate.

Stubby: Wool that is very short, a short clothing wool.

Suint: Dried perspiration from sheep, present in all grease wool.

Taggy: Containing excessive tags.

Tags: Heavy, dungy wool.

Tar: One of the off sorts; stained by paint brands used on sheep. All brands are classified as tar by the sorter whether or not the substance is real tar.

Tender: Lacking in strength, unsound.

Territory wool: Produced in certain western states, largely those in the Rocky Mountain area. The term originated through the fact that most of these states were important for wool growing before they were admitted to statehood.

Timber-burned: Blackened by the sheep grazing on cut-over land on which the stumpage, deadfall, and slash have been burned or charred.

Top: A continuous untwisted strand of wool made up largely of the longer fibers resulting from the combing process.

Top-making wools: Average combing and Big French wools of the finer grades.

Unmerchantable: Carrying excessive defect.

Virgin wool: The definition varies in the different states. In California it is wool that has not been carried beyond the scouring or scouring and carbonizing processes. Noils, card waste, burr waste, and many other by-products of manufacturing are specifically declared not to be virgin wool.

Warp: Threads or yarn that run lengthwise of the cloth.

Warp wools: Suitable for making warp yarns; must be well grown and have superior strength.

Wasty: A wool that is not well grown and will provide an unusual amount of "waste" products, particularly noil, in manufacturing.

Woolen: Fabrics or yarn made of uncombed wool.

Worsted: Fabrics or yarn made of combed wool.

Yarn: A continuous strand of any textile fiber made by pulling it and twisting it simultaneously.

Yield: Percentage of the weight of grease wool left after scouring.

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